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Volume XX July, 1920 Number 2

BULLETIN NO. 13

OF

The New York State College of Forestry

AT

SYRACUSE UNIVERSITY

Forestry for the Private Owner

BY

FREDERICK FRANKLIN MOON

Professor of Forest Engineering

AND

HAROLD CAHILL BELYEA

Assistant Professor of Forest Engineering

Published Quarterly by the University, Syracuse, New York

Entered at the Post Office at Syracuse as second-class mail matter

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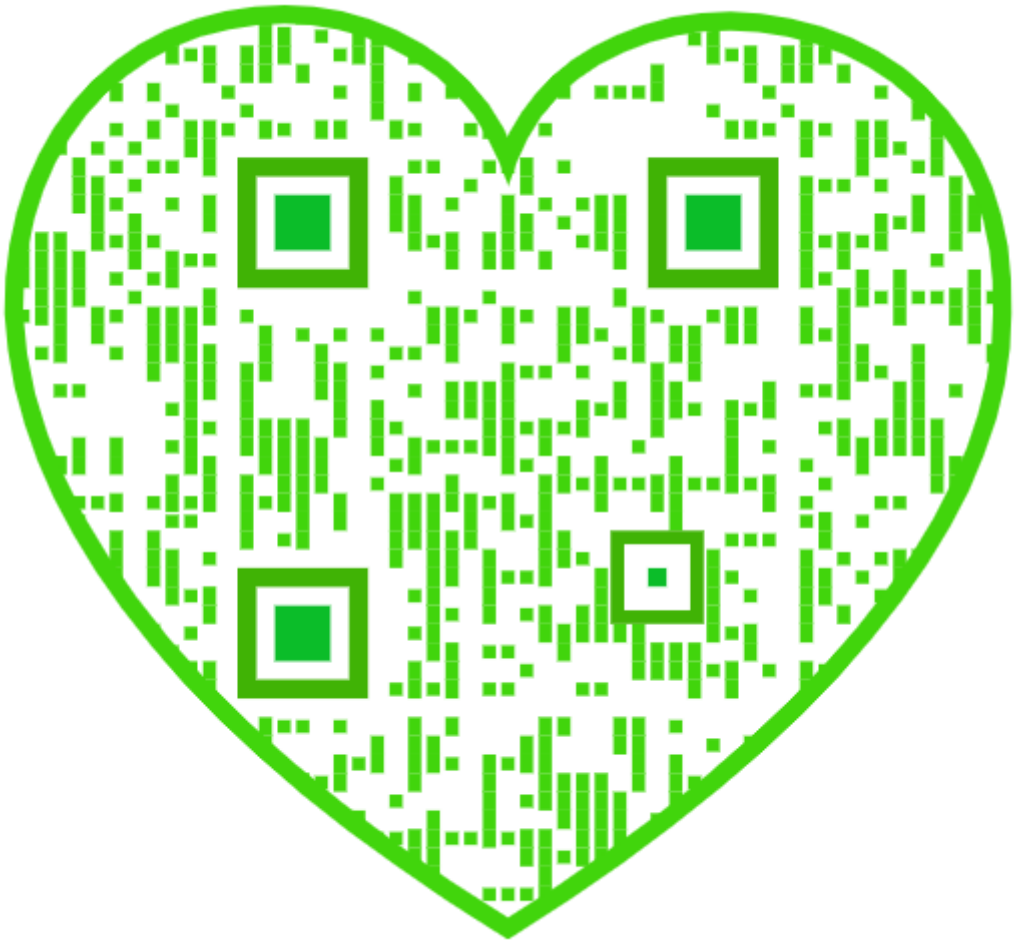

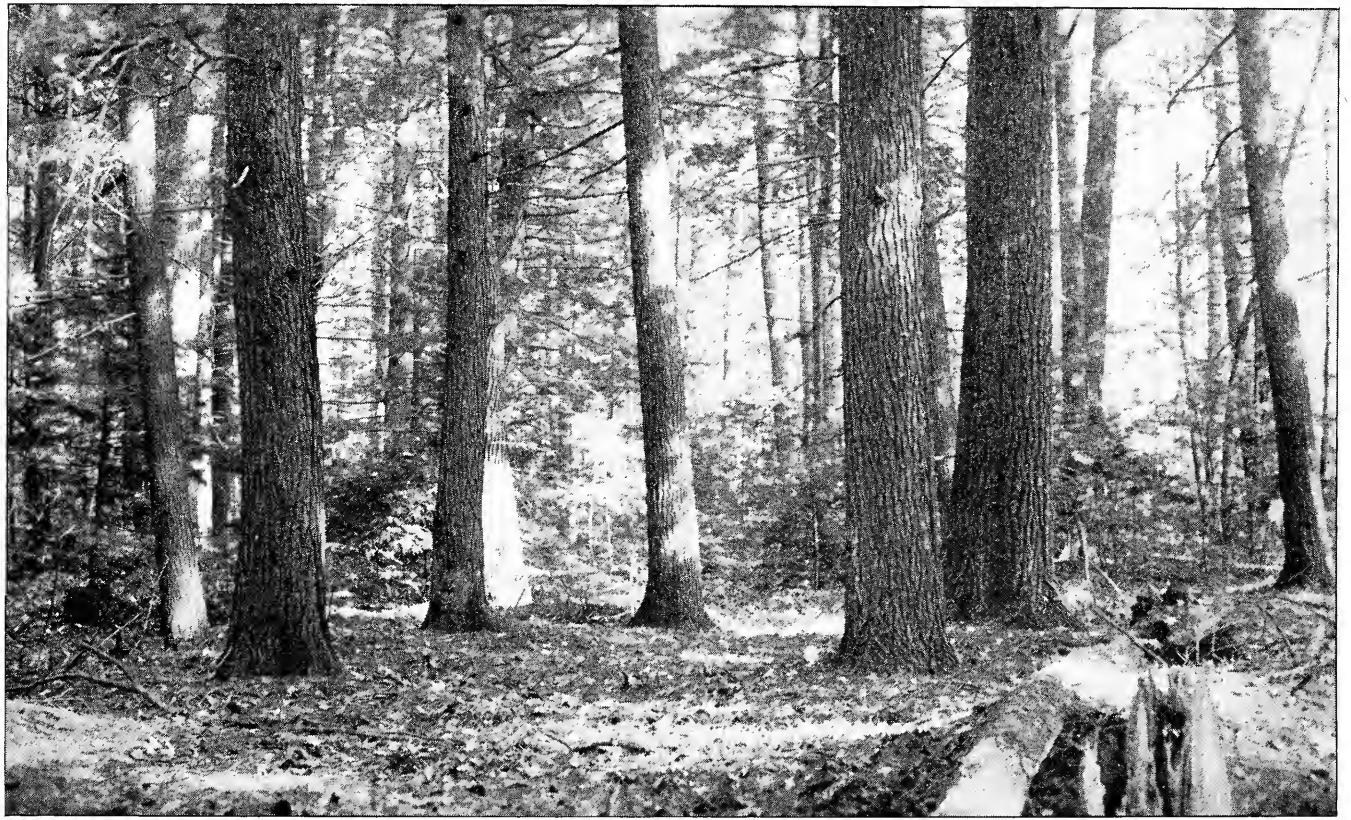

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FOREWORD

In spite of the books and bulletins which have been written about the farm woodlot, there is no type of forest property which elicits so many questions.

Can the woodlot be made to yield a cash revenue? How and when should it be cut? How can a small amount of logs or sawn lumber be profitably handled? These and countless similar questions are being asked the New York State College of Forestry.

In 1912 the College commenced taking stock of forest resources, planning to cover all of the State except the twelve Adirondack counties in which the State forests administered by the Conservation Commission are located. This work was continued during the summer seasons of 1913 and 1914. In the latter summer, four of the forty-five counties were covered by four post-graduate students working under the supervision of one of the faculty. Upon this reconnaissance a vast store of information was acquired regarding the condition and need of the woodland, the past and present treatment; the values of standing timber and manufactured products, logging and marketing costs, etc. In short, facts were gathered which would enable the College to answer intelligently and accurately the question, "What can I do to make my woodlot profitable?"

However, to complete such a survey takes a great deal of time in a state the size of New York; consequently it seemed better to issue a general bulletin which would cover the main points in woodlot management as a progress report, pending the completion of the statewide forest survey.

The College of Forestry as a state-supported institution is endeavoring to render the maximum service to the entire State. By assisting the private owner to grow, cut and market his forest products with the greatest ease and profit, the College feels it is doing much to solve the land problem in New York. Forestry will prove no panacea for all economic ills, but unless the 12,000,000 acres within the state that are unsuited to agricul-

ture can be made to yield their maximum return, the permanent prosperity of the State is impossible.

The real problem of the farm woodlot is not so much that it should and can be made the producer of a valuable and revenue-yielding material, timber, as it is the factor of disposing of this material at a profitable figure to the owner. In short, the problem of woodlot forestry is mainly the problem of marketing its products. And marketing the products of the farm woodlot to advantage is just as important and is confronted with similar difficulties to marketing any of the other products of the farm. Given access to the means and methods of profitable marketing, it will be but a short time before every farmer will make his woodlot contribute to an important part of the revenue of the farm. Fuller utilization of its revenue-producing capabilities will mean an added knowledge of the cultural and silvicultural methods of woods management which we call forestry.

CHAPTER I

INTRODUCTION

What is Forestry? Forestry is the raising of repeated forest crops from non-agricultural soils and the proper utilization of these crops.

A lumberman who is clear cutting forest land is ordinarily not concerned with another crop of trees, and hence is not practicing forestry. Neither should a wealthy estate owner who plants up ten fertile acres with pine trees think he is engaged in forestry. Such planting is "arboriculture", and should be considered landscape improvement. The forester, who is first of all an economist, insists that each acre of land should be put to its most profitable and best permanent use; that trees should be grown only upon land which is too steep or too stony for tillage or too sterile for the production of field crops. Certain exceptions will immediately be thought of, *e. g.*, the catalpa plantations of the Middle Western States, but the main principle holds true.

The development of forestry to include the utilization and marketing of the forest crops is comparatively modern. Agriculture for a long time concerned itself with crop production alone, but within the past decade it has expanded to include many phases of specialized manufacture and distribution of farm products. At present the formation of cooperative buying and selling associations is considered an important phase of the work of the Federal Department of Agriculture. The same principle holds in forestry.

In addition to timber crops the forest may yield other valuable products with whose management the forester is actively concerned. For instance, in the West, thousands of head of cattle graze upon the national forests, and the United States Forest Service derives nearly half its revenue from grazing fees. In continental forests the propagation and protection of game requires a large measure of the forester's attention, and the returns from shooting privileges constitute a considerable

part of the average forest income. In this country the game question is receiving greater attention by the foresters each year, and the game supply of the future can be assured only by the intelligent cooperation of the men in charge of our forest areas. Thus forestry is concerned with all phases of forest production and distribution, and the field is constantly growing wider.

The Need of Forestry

The forestry problem in this country and in New York State is essentially one of economics. Land which can produce no other crops at a reasonable profit must be made to yield forest crops, since idle land is a detriment to the State at large as well as to the owner.

Forestry is needed in New York for four principal reasons:

I. There are large areas unsuited to agriculture which must be kept productive. Of the total land surface of the State (30,000,000 acres) about twelve million acres are *unsuited to agriculture under present economic conditions.* The forester insists that this land shall not lie idle but yield a revenue to its owner. There are in New York State to-day 4,400,000 acres of unimproved non-agricultural land within the farm fences. These constitute the big woodlot area of the State. The greater bulk of this land, say 4,000,000 acres, is capable of producing 200 board feet per acre per year, or an aggregate for the State of more than one billion board feet. The yearly lumber bill of New York, is around $125,000,000, of which more than $85,000,000 is sent and spent out of the State of New York. This money should be spent within the State for our own grown lumber, paying for our own labor and being deposited in our own savings bank. *Forest crops solve* this problem.

II. The products of the forest are indispensable to our civilization. In spite of the increasing use of substitutes, steel, concrete, etc., wood materials possess properties which, for certain purposes, make substitution impossible. Twice as much timber per capita is being used as was consumed thirty years ago. Furniture, flooring, books, newspapers, all depend upon the forest for their supply of raw material, and our transportation systems which distribute coal, provisions, etc., would be

absolutely crippled without railway ties and telegraph poles. Under circumstances as they exist to-day a shortage in forest products would be felt almost as keenly as a famine in foodstuffs. Fernow* states that 95 per cent of the timber consumed goes into necessities, and that "from the cradle to the coffin" we are surrounded by the products of the forest. Proper care of the forest growth and close utilization of its products are matters of prime importance to each and every citizen of the State of New York.

III. The indirect influences of the forest make them of incalculable value. For many years the forestry movement in this State received the bulk of its support from a body of men and women who loved the woods and the lakes, who urged the protection of forests and waters because they were beautiful and gave pleasure to countless nature lovers, and because unconsciously they felt that these influences were extremely valuable. To-day while affirming that the main arguments in favor of a vigorous forest policy in New York State are based on economic grounds, we also realize that these aesthetic and so-called indirect influences have a very high value, some of which may be readily expressed in dollars and cents.

Climate

Among these influences the importance of forest cover in moderating climatic extremes and in increasing the amount of precipitation are often cited. It is an experience common to anyone who lives in the country that upon a cold winter day it is always warmer within the forest than in the open fields, and during the summer season the forest canopy, by protecting the soil from the direct rays of the sun and keeping the ground shady and moist, keeps the atmosphere within the forest appreciably cooler. Thus large bodies of forest undoubtedly assist in rendering the climate more agreeable; however, the effects of forest cover upon climate are necessarily local.

Precipitation

Concerning the influence of forests upon precipitation, the evidence is somewhat difficult to secure. Investigations carried

* Fernow, Economics of Forestry, chap. 2.

on by European foresters have proved that large masses of forest cover located upon mountain tops undoubtedly do increase the amount of snow and rainfall locally. Zon* believes that the amount of precipitation enjoyed by the states lying in the interior of this continent is dependent to a large degree upon the amount of forest cover situated across the track of prevailing winds.

Run-off

Concerning the influence of forest cover upon the run-off of rain and snow, the effect is much more readily demonstrated, since the sponge-like action of the tree canopy, trunks, root systems, and finally the marvelous water-holding capacity of the forest floor is readily understood by the average citizen. From 25 per cent to 50 per cent of the water falling during a summer shower never reaches the ground, since it is intercepted by the leaves and branches and evaporated directly into the air. When an unusually heavy shower falls, or when the snow is melting in the springtime, other parts of the forest come into play.

The humus, that organic layer composed of leaves and twigs lying on top of the soil, possesses great water-holding capacity, being able to contain several times its own weight of water. If the rain is sufficiently heavy to soak this layer completely, then the water collects upon the surface of the ground in the hundreds of miniature storage basins, surrounded by the buttressed tree trunks. Finally the deeply penetrating roots open channels into the sub-soil, where the water can seep to reappear days afterward, when all flood danger is passed. Briefly expressed, a cutover watershed, especially one from which the humus has been burned either by a slash-fire or by the sun's rays, resembles a tin roof from which the water runs with great speed into the spout (stream) at the foot of the slope. A watershed well forested behaves like a roof covered with a heavy layer of sponges. Only the excess runs off immediately, leaving the balance to gradually drip into the spout (stream) and evaporate slowly into the air. Forests alone will not always control a bad flood situation, but a dense forest cover, together with many small

* See Final Report of the National Waterways Commission, p. 226, Appendix V. Washington, D. C., 1905.

storage reservoirs along the course of the mountain torrents, have been found by the French foresters most efficacious in reducing the amount of flood damage. In short, it has been proven by the experience of foresters in Europe that the conservation of water and the conservation of forests go hand in hand. They are interdependent problems.

Recreation

The recreational value of our national and state forests is one that has been by no means overlooked in the past and should certainly be considered in the future, because anything which benefits the health and strength of the citizens is in itself a tremendous asset to the State. In addition, the recreational value of the Adirondacks and Catskills yields very large cash returns to thousands of people in the form of railroad fares, wages to guides, hotel and camp employees, etc. It was estimated by the Conservation Commission, some years ago, that during an average year, the sums expended in the Adirondacks by summer tourists, fishermen and hunters are upwards of $18,000,000. This is a large return, but by far the largest return is found in the increased vigor and courage which these citizens take back after their days or weeks of playtime spent in the life-giving North Woods.

However, some ardent advocates of forest protection refuse to admit that the same piece of ground can conserve the run-off of life-giving water, can serve as a hunting and fishing ground for the tired desk or shop worker, a breeding place and haven for fish and game, and at the same time can yield a revenue in the form of timber crops.

Plenty of evidence to prove that forest land need not be left in virgin condition to please the hunter and tourist is available both at home and abroad. The noted resorts of the German Black Forest are for the most part located in regions yielding handsome revenues from the sale of matured timber without in any way destroying the beauty of the mountain slopes nor the breeding haunts of the game. The national forests in the same way serve the public as recreation grounds without being locked up against proper cuttings. Viewed from all sides the forest areas are a priceless resource, and the state which does

not adopt a far-sighted and liberal policy in the management of its non-agricultural lands falls far short of its full duty to the future citizens.

IV. Forests are valuable to the individual owner and especially to the owner of small wooded areas or woodlots.

1. *As a means of utilizing non-agricultural land*

True farming land is that which can be made to produce profitable food crops. There is on every farm in New York State, more or less land which will produce no other crop but timber, because it is rough, steep, stony, worn out, poorly drained, or too far back on the rear of the farm to be managed successfully. There is practically no land in the State which will not produce profitable and successful timber crops.

2. *To meet the actual needs of the farm for wood material*

There is always a certain amount of repair work or construction to do about any farm, fences to build, posts to set, fruit trees to be braced, out buildings and barns to be re-silled or re-floored.

There are 167,000 farms in New York State each of which uses, on the average, the equivalent of 5,000 board feet of lumber per year for general repair and construction. This amounts to more than 800,000,000 board feet each year. All of this timber should be grown on the farm for home consumption, and in addition to the cash expenses saved thereby, there would also be saved to the agricultural population of New York State freight charges totaling up to enormous sums. In short, the natural source of all wood material used on the farm should be the farm woodlot.

3. *To meet the demands of the farm and local fuel situation*

Between 1910 and 1915, due to the great improvement in state road construction and the increased efficiency of motor transportation, except in the more remote rural communities, coal, to a great extent, supplanted wood as a fuel in farm homes. The experience of county fuel administrators during the coal shortage of the war period, and the increasing cost of coal itself to the consumer, seems to indicate that in the future, its use as

a fuel for homes in the rural communities will decrease considerably and that the use of wood fuel will come back. The natural source of wood fuel on the farm is of course the farm woodlot.

4. *As a means of protection and regulation of the farm water supply*

A forest growth at and above the "spring under the hill," which supplies the farm with its drinking water, protects against its drying up, by the water storage powers of its forest floor in seasons of drought, and against its silting up and filling in, in times of heavy rains and floods. Thus an ever-abundant supply of water is conserved and its purity for use assured.

5. *As a profitable means of utilizing labor during the winter months*

This is especially a consideration where the problem of keeping and utilizing good labor and help is important. The proper development of the farm woodlot offers the most satisfactory solution of this problem.

6. *As a protection against winds*

The location of the farm woodlot can bear a very definite relation to and exercise a very beneficial influence over the *personnel* and activities of the farm and farm management.

a. As a protection to buildings

A narrow belt of woods properly located in between the farm buildings and the prevailing winds, will break the force of the wind, and to a great extent moderate their severity and temperature and add greatly to the comfort of the home and of the stock in the barns. Even in winter, when the hardwood trees are stripped of their leaves, such effect is very considerable. It is even greater in summer.

b. As a protection to growing field crops

While along the south and west sides of cultivated fields, the effect of neighboring forest growth, to a certain extent, is to shade out and retard the growth of planted crops, nevertheless

the beneficial effects of neighboring woodland growth quite overbalance this. The force of heavy, hot, drying winds is broken, and the soil of the cultivated field is protected from rapid drying out of the surface layers. The delicate plants of early truck crops can be protected against the blighting effect of cold north winds. Orchards, especially when heavily branched and heavily laden with a rapidly ripening crop, are protected against breakage and loss.

c. As a protection to pastured stock

Dairy herds, or fattening and young cattle, are kept in better condition, look better, and yield better returns, if they can have the advantage of tree shade in fly season, or in the heat of summer. It is not advisable to turn over the whole of the woodlot for the pasturage of cattle. Such practice is very harmful to the best condition of the woodlot. Narrow fringes of a woods or tree growth along stream borders, ridges or pasture fences are more desirable and fully as efficacious.

7. *As a means of increasing the attractiveness and value of the farm*

Woodlands make the farm more attractive, more homelike and more desirable for purchase. The existence of a thrifty piece of woodland may add from one to three thousand dollars to the value of a farm for sale.

Possibilities of Forestry in New York

New York is naturally a great forest-producing state, and its potential forest wealth is second only to its agricultural richness. It is endowed with all natural factors which permit trees to germinate and grow successfully; soil, rainfall, climatic extremes and length of growing season are all favorable, and it is not surprising that in many parts of the State when fires are prevented, the forest reclaims open fields and abandoned pastures with amazing speed. It is the artificial conditions arising from our rapidly growing civilization which have made such tremendous inroads upon the original.

Original Forests

Prior to the coming of the white man, the area which now constitutes New York was practically an unbroken wilderness, the only clearings being those occasionally found along the shores of the lakes or at strategic points, like the junction of streams, where Indian villages were located. The rest was a vast primeval forest.*

From the remains of old stands of first growth timber, it is occasionally found possible to reconstruct a fairly accurate picture of the forest which then covered the ground. Then, as to-day, the North Woods were covered with a mixture of evergreens (spruce, balsam or hemlock) and hardwoods; the latter being largely beech, birch and maple. On Long Island, extending up the Hudson and Mohawk Valleys and fringing the larger lakes, were stands composed of huge oaks and chestnuts, mixed with basswood, ash and tulip poplar, and liberally sprinkled with hemlock and pine. The two latter species, being unable to sprout from the stump, have practically succumbed to the century-long struggle against axe and fire, and as a consequence have largely disappeared from the mixture. Only the best sprouters have survived, while the more desirable species, in many places, have been completely exterminated.

Upon the hilly lands in what now comprises the southern tier of counties was found the superb forest reaching up from Pennsylvania, in which hundreds of white pine were of leading importance. The softwoods, or evergreens, on account of the lightness and ease of working, were heavily cut. As a result we have the usual consequence of reckless forest management pursued over a long period, "the *survival of the unfittest*" (for use).

Present Conditions

It has been said of New England that had not trees been endowed by Providence with a marvellous faculty of holding

* Bertram, in his "Observations" (1750) concerning the forests of southern and central New York, says: "We observed the tops of the trees to be so close to one another for many miles together that there is no seeing which way the clouds drive, nor which way the wind sets; and it seems almost as if the sun had never shone on the ground since the creation."

fast to territory in the face of the most terrific onslaughts, the country would be as bare as the plains. The same statement might be made of New York with equal truth.

Viewed as a menace by the early settlers, the splendid forests were attacked with fire and axe until the land needed for tillage was cleared. The practice of cutting and burning trees to clear the land persisted long after the need for such wholesale clearances had passed, and as a consequence local stringencies in forest products were early felt by the colonists.

At present the forest land in New York is suffering from the wrong point of view. With the wealth of timber resources with which this country was originally endowed, it is not strange that the idea that our forests could not be exhausted became widespread. As a consequence, forest land was treated as a mineral lode, a resource to be stripped and then thrown aside instead of being handled as an area capable of yielding repeated crops. In fact, with forests as with agricultural land, minerals, animal life, etc., the very richness of this continent in all natural resources has been responsible for the spirit of lavish prodigality which marks their management. In the case of precious metals, coal, oil and gas, when the supply is gone, the tale is told, but with forests timely measures will secure a return of this resource. On account of the slowness of tree growth, these measures should be begun long before the day of actual need.

The forests of New York have suffered because it has been deemed unprofitable to manage them conservatively; because it was believed impossible to secure an annual or periodic revenue over a long period of years. In the early part of the past century, the small, privately owned timber lot supplied the needs of the owner and small local demands. With the building up of the vast railway systems and the development of superior merchandizing methods by the larger lumber corporations, it has been far easier for the small woodlot owner to buy the few thousand feet of Western or Southern lumber from a local dealer than cut, skid and saw the logs himself. When the timber upon the lot was mature, the stumpage was generally sold for a song to a portable mill operator who skinned it regardless of its future conditions. Thus, the average farm woodlot in New York has been cut and recut; it has been burned and

burned again; it has been grazed repeatedly till the diseased and undesirable specimens left standing could draw but little sustenance from the compacted and exhausted soil. After being used as the catch-all of the entire farm, it has been abused because it is not continuously productive nor financially profitable.

This condition has its serious aspect, not only from the standpoint of unsound national and state economics, but because the timber supply of the future is in private hands. In the United States, three-fourths of the standing timber is privately owned (ten per cent being held in farm woodlots), while in New York State, two-thirds of the timber is in private hands. Since we are cutting timber three times as fast as it is growing, it is high time that steps were being taken to utilize the privately owned forest land, especially that portion owned in connection as farm woodlots or larger tracts owned by the farmers of the State and and nation. The successful practice of forestry by the small landowner must be assured if our children's children will have a good supply of wood obtainable at a reasonable price.

Remedies

How can the small landowner be induced to practice forestry to protect his woodlot; to cut his timber himself, or if sold, to have it cut according to silvicultural methods and not as the owner's grandfather cut? The answer is, by making forests profitable. The average owner will not trouble himself about property that yields little or no income. Show him profit and suggest the right management and the progressive owner will soon fall in line. The owner of large areas of woodlot, which may have been previously producing no financial returns, will find little difficulty in marketing his forest crop, either as stumpage or manufacturing products, at a reasonable price. The owner of a few acres of woodland is not so fortunately situated. The amount of timber to be felled and sawed may not be large enough to furnish a mill set up, or if so, he may not have sufficient stumpage to saw car-lots of his best species. The usual result is that such stumpage and such small parcels of lumber are sold for a song.

How can this situation be remedied? By educating the private owner of timber lands in New York concerning the present and future value of his holdings, and by direct assistance in marketing his forest crops.

Since its establishment, the College has endeavored through grange and club lectures, bulletins and circulars to reach the public and inform them concerning the value and possibilities of their forest property.

In addition, upon the four Experiment Stations being operated by the College in different parts of the State, problems common to each particular region are being worked out so that specific replies may be given to questions which may be asked. Finally it is the aim of the College, through its Extension and Utilization Services, to assist the small owner and manufacturer of forest products in marketing his wares with the greatest amount of profit. If profit can be assured, probably little further inducement will be necessary. It is the aim of the College to make every acre of non-agricultural land within the State yield a good return to its owner, and to render its return to the State by supplying opportunities for labor to citizens of the future, and, at the same time, supply repeated crops of timber, material absolutely indispensable to our civilization.

With practically one-tenth the total population of the nation situated within the boundaries of New York, with a perfect net work of steam and electric lines, with the canal system providing splendid facilities for the transportation of heavy freights, the problem of economically marketing and distributing the products of the woodlot should not be difficult. However, custom and lack of knowledge must be overcome. The farmers and small owners must be made to realize that woodlot activities will solve the labor problem during the winter months, and in addition, will supply farm timbers, sills, fence posts; that the farm woodlot will yield a handsome return upon the capital value it represents. Then, and not until then, will the private owner be actually interested in the practice of forestry.

CHAPTER II

THE WOODLOT

Importance. The forest products obtained from the farm woodlot and small timber lots owned by members of the rural population are vastly more important than is generally believed. Moreover, with the steady decrease in the forest area and amount of standing timber throughout the State, their relative size and importance is rapidly increasing.

In the United States, as a whole, it is estimated that nearly 200,000,000 acres, out of the 545,000,000 acres of forest land (containing 10 per cent of the national timber supply) are contained within the farm woodlots. According to the census of 1900, $109,000,000, and in 1910, $195,000,000 was received from the sale of woodlot products. In 1910, in eight out of twenty of the eastern states, woodlot products were considered as one of the three leading crops and sources of revenue of the farms. The increase in values between 1900 and 1910 may not indicate enlarged interest or greater exploitation of the woodland owned in connection with farm property, since a part of this difference was doubtless due to cuttings for the purpose of clearing lands for agriculture. It is nevertheless true that the value of woodlots and their products will show a decided relative increase during the next generation owing to the rapid decrease of the national timber supply.

In New York it is estimated by the Conservation Commission* that out of the approximately thirty million acres of land area, 4,400,000 acres are held as woodlots. No figures regarding the income now being derived from this area are available, but judging from results obtained in certain parts of New England, were economic forestry practiced upon this portion of the farm holdings, and in addition were the seven millions of acres of land fenced, but unimproved and idle,† put under forest

* Bulletin 9 — Woodlot Forestry — published by N. Y. Conservation Commission, 1913.

† Abstract U. S. Census 1910, p. 307.

management, the income of the farmers and small landowners of New York would be increased by several million dollars each year. Areas in Germany, France and Switzerland, similar in character and supporting tree growth of the same genera, but different species, pines, spruces, fir, etc., are yielding from two dollars to four dollars per acre per year net revenue. A tithe of this income would make a large difference to the income of the State especially when it is realized that the State is sending outside its boundaries each year for wood products, the sum of $85,000,000, and when it is appreciated that for each dollar that is paid for stumpage, approximately four dollars is paid in wages to convert the raw material, the tree and the log, into the finished product.

Whenever such facts as the above are cited, objections like, "Oh, yes! but it takes forty-five to fifty years to grow a tree," or, "The income from forest land never will amount to much," etc., etc., are heard. In view of the fact that the sum of all city, county and state indebtedness amounts to approximately $47.50 per acre, that the cost of running the State Government has increased from $42,000,000 in 1909 to $120,000,000 for 1920 during the past nine years, that a direct tax to supplement the insufficient revenue of the State is necessary, the State of New York and its citizens can by no means afford to overlook any source of steady revenue however small, especially when this possible revenue means more income to the property owners, more wages to labor, larger receipts to transportation companies —in short, statewide prosperity. The permanent prosperity of New York State is absolutely dependent upon the proper use of its land, both tillable and non-agricultural, and realizing that such development takes time, a proper land policy begun now is positively necessary. Such a policy, however, can only be inaugurated after the completion of a state-wide survey and land classification so that the possibilities, whether agricultural or forest, of each acre within the State may be definitely recorded.

Woodlot Problems. On account of the range of climatic conditions and the forest types resulting therefrom found within New York State, the forest problems are many and varied.

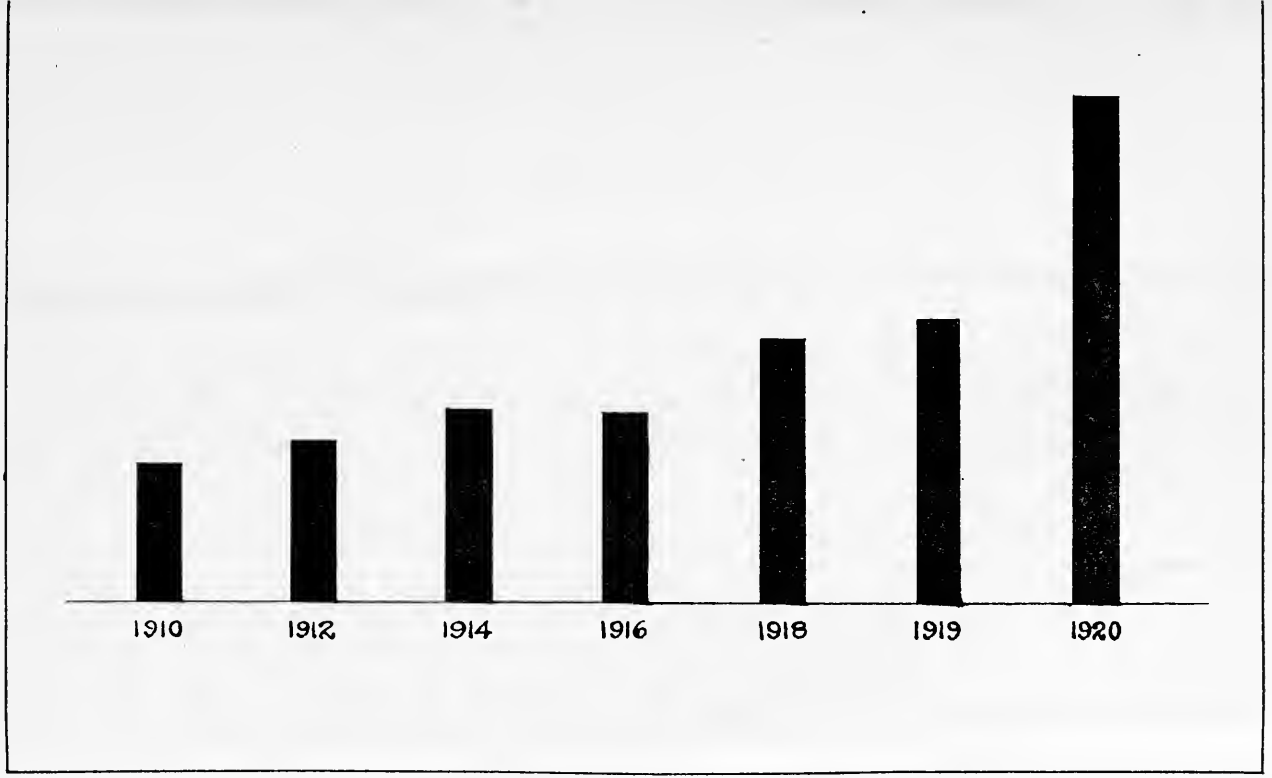


PLATE 1. Graphical representation of the growth of the New York State budget appropriations between 1910 and 1920. In 1910 the appropriations amounted to $38,300,000; 1912, $44,800,000; 1914, $53,800,000; 1916, $52,700,000; 1918, $73,300,000; 1919, $78,900,000; 1920, approximately $120,000,000.

According to Bray* at least five distinct forest zones or regions have been differentiated. They are as follows:

I. Southern species, consisting of persimmon, sweetgum, etc. (Found only on Staten Island and on the southern shore of Long Island.)

II. The sprout hardwood type—common throughout the Hudson, Mohawk and all the river valleys of the southern tier of counties. This type is also found along the shores of the Great and Finger Lakes.

III. Northern hardwoods, comprising the forests of beech, birch and maple found in the higher land along the southern tier of counties and in the foothills of the Adirondacks.

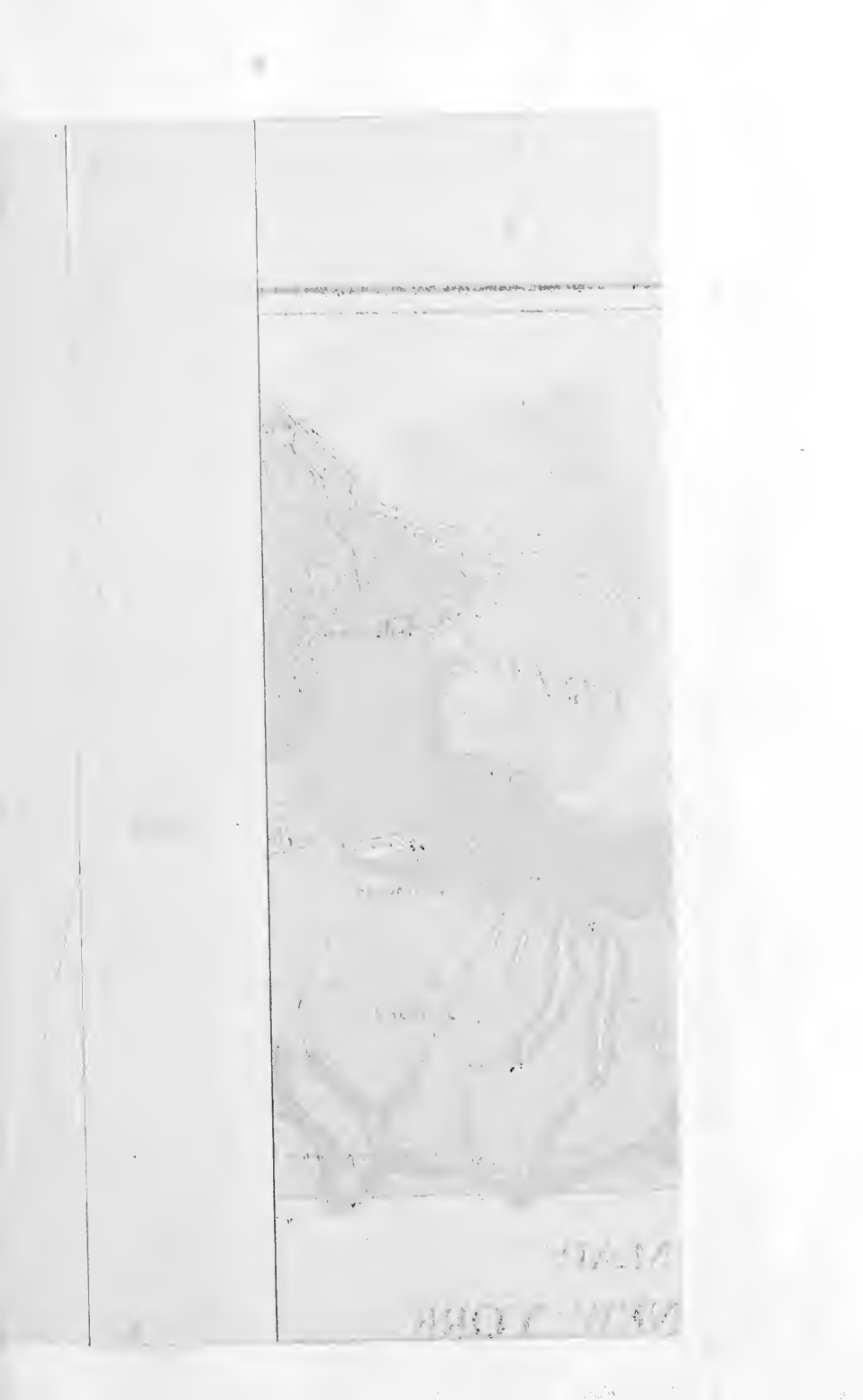
IV. The coniferous forest, of the Adirondack region and the Catskill mountain tops.

V. Sub-arctic type—found in the highest elevations of the Adirondacks (consisting of dwarf plants and polar vegetation).

Within each of these regions the management of the forest presents a distinct silvicultural problem, and within each region a different set of economic and market conditions prevails, so that intensive management would require different specific recommendations for each woodlot located in those regions. While the College of Forestry is loath to give advice regarding forest management of any property at long range, nevertheless, under certain circumstances, broad rules of management can be given which will be of great assistance in properly handling the woodlot.† It will be noted, in the chapter devoted to the hand-

* The Development of the Vegetation of New York State by Dr. William L. Bray, Vol. XVI, November, 1915, No. 2—Technical Publication No. 3—The New York State College of Forestry at Syracuse University. See map in index.

† As a part of its state-wide educational work, the State College of Forestry offers to make plans for the protection and management of timberlands and woodlots for the reforestation of cut-over and barren areas. Where the timberland, woodlots or barren areas are between 300 and 1,000 acres and where there is reasonable assurance that plans will be carried out, they will be made at no expense to the owner. Where there is less than the above amount, it will be necessary to have owners pay expenses of traveling and sustenance while the plan is being made. Owners of smaller tracts may combine, and by bringing the area to 300 or more acres, have plans made without cost.



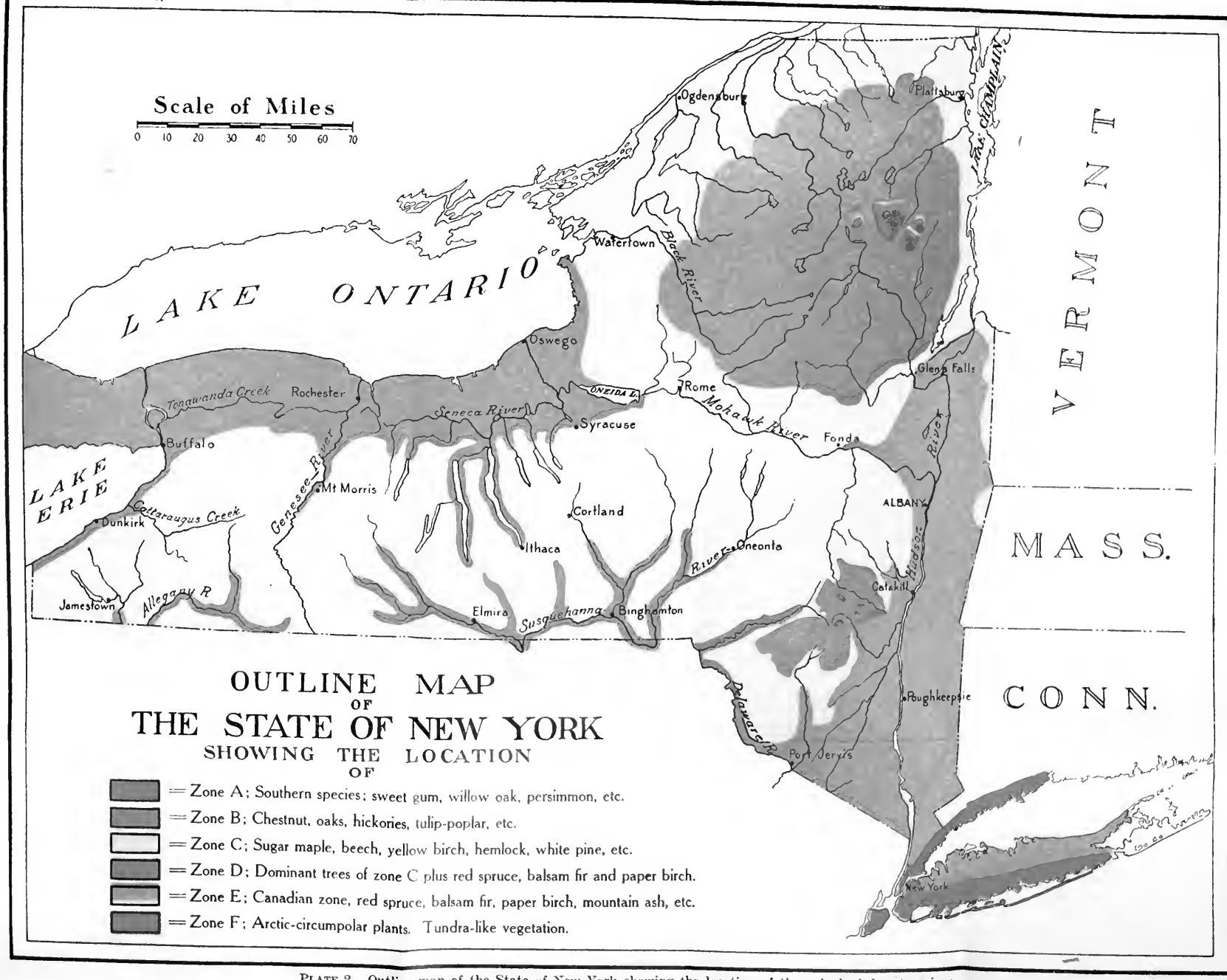


PLATE 2. Outline map of the State of New York showing the location of the principal forest regions

ling of the woodlot, that THE SYSTEM OF MANAGEMENT RECOMMENDED FOR THE WOODLOTS IN EACH OF THESE FOREST REGIONS IS PRACTICALLY IDENTICAL AS MARKET CONDITIONS AND THE NEED OF THE OWNER (A CASH REVENUE EITHER EVERY YEAR, OR SAY EVERY TEN YEARS) MAKE A SINGLE TYPE OF CUTTING DESIRABLE. Hence, the system of management advised has been adapted to the needs of the owner rather than adhering to a strict silvicultural system.

Possibilities

To the farmer of fifty years ago the woodlot was an important part of his farm because it produced materials of value, both for home consumption and for sale, besides it gave occupation to men and teams during the slack winter season. With the development of the Western and Southern forests following the Civil War, a different situation arose. In the West enormous tracts of land were given by a generous government to transportation companies for the purpose of encouraging the building of rail and wagon roads. These tracts were either retained by the original corporations, or sold in enormous blocks to lumber companies. These companies, operating on a gigantic scale, soon developed a splendid system for merchandizing their wares, assisted by the network of railroads which have been built during the past forty years and by the cheap freights afforded by water transportation in coasting vessels. The result is, that in many states domestic lumber has been largely driven from the market, since southern pine and western fir are offered "just as good" by the local dealer who buys cheaply with excellent arrangements for credit.

The result could be readily foreseen. Trade, like any moving object, follows the path of least resistance, and it soon became much more convenient for the casual purchaser to use southern pine manufactured in a large mill possessing excellent machinery, and carried by the local yard in all sizes and grades, than to use local lumber indifferently sawed into a few set dimensions, and poorly graded. As a consequence, local lumber has fallen into disrepute, and for various reasons state timber very often commands a lower price than the same species shipped in

from some large mill outside the State. The small mill run by water power is rapidly disappearing, custom sawing in permanent mills is becoming a thing of the past, and nowadays about the only way a small landowner can get any lumber from his own woodlot is to hire a portable sawmill to set up on his property and saw out the necessary material. Such a set-up is rather costly, and as a consequence, much more timber is usually sawed than is needed at that time.

As a consequence, the common attitude toward the woodlot has been one of almost indifference, whereas, in former days when the winter's wood or the needed barn sills were being cut, such cuttings were located where they would do the most good. Big spreading trees which were crowding a group of young pine seedlings, dead and diseased individuals, trees of undesirable species—weed trees—were cut. This meant a gradually improving woodlot, one that was known to be a producing portion of the farm, and its value was fully appreciated. With the increasing use of coal, with the growing difficulty in getting joists and planks sawed out of home-cut logs, the typical New York woodlot has been allowed to run down. Trees when cut for home consumption, nowadays, are most commonly cut near the road—where they are easiest to load—rather than removed where they will improve the condition of the woodlot. The trees of desirable species are taken for beams and sills, and the ground left in command of the weed trees which are not slow to cover the area with their offspring. Fires are allowed to rage unchecked—"What difference does a fire make, it doesn't kill the big trees." Cattle are allowed to graze at will within the woodlot, eating many of the seedlings and trampling upon more.*

Or, if the owner leaves his forest land untouched for a score of years, it will one day attract the attention of a portable mill owner who offers, as a rule, a lump sum for all the standing timber upon it. Such an offer is generally accepted, for who can resist money, especially when it is offered for a crop it cost nothing to grow, and which at present is yielding nothing? And so the average owner parts with his timber, having sold

* See pages 40 and 46 for damage caused by forest fires and grazing.

it for a song — "unsight unseen" — with no idea of how much timber he had or what will be the market value of the manufactured product, or, how the land will be left when the job is finished. Then the mill man sets up his mill, cuts just as he pleases—unhampered by a written contract—all the sound trees of desirable species, and leaves the ground covered with a tangle of slash above which tower the few decrepit and diseased individuals of marketable variety and the hundreds of weed trees which are not saleable. In most cases fire finishes the job, and a forest productive and attractive, in a few months is changed into a waste, ready to be occupied by briers, grasses, and a thicket of young weed trees instead of seedlings of the more desirable species.

After a decade or two, such a mangled woodlot—representing the "survival of the unfittest" (for use)—becomes still more an eyesore, and the present owner unaware of the former condition and possible future value of such a run down piece of woodland, continues its abuse—when *proper use* would make it both attractive and profitable.

What is the remedy for this situation? How can the four and one-half million acres within New York, handled or mishandled for the most part, according to the above recipe, be restored and made profitable?

By education and cooperative demonstration.

Our forefathers derived materials, occupation and income from the woodland owned in connection with their farms, and the vanishing timber supply will make such products of far greater value in the future than in the past. Since forest crops take time to mature, the beginning should be made immediately.

The New York farmer should, first of all, consider the woodlot a producing part of his farm, one capable of yielding a steady though periodic income. He should be taught that cultivation of his woodlot crops pays excellent dividends; that the crop produced grows while he sleeps, and, since it is not perishable, may be held over for months or years until market conditions are right. He should learn to estimate the amount of timber standing on his property and its rate of increase. When he is

ready to sell his products he should be businesslike in the transaction and demand a fair price. No farmer would dream of selling a bin full of pears or apples for a lump sum without measuring the fruit, yet scores of owners sell their standing timber without knowing how much they have or how much they should receive.*

The fashion of custom sawing should be revived, and with the increased activity in woodlot work and the growing appreciation of water power, there is little doubt that many of the abandoned dams and neglected mill ponds which dotted rural New York in former days will be restored, and the small mill will again saw lumber and grind meal for the local people.

The growing activity of the County Farm Bureaus, and the increasing number of Farmers' Cooperative Associations holds forth much promise. Already the cooperative marketing of fruit and vegetables has been tried with remarkable success in certain parts of the country, more particularly among the fruit growers of the far west. From cooperative marketing of farm field products to cooperative marketing of farm woodlot products is but a short step, and there is no reason why the county agent of the next decade should advise concerning markets, prices and methods of selling the products of the woodlot. Where no county or local cooperative buying and selling associations are found, an aggressive grange might take charge of the marketing end of the woodlot. It is not always possible for a single farmer to furnish a sufficient amount of any one kind or size of material to warrant a sale, and in true union there is strength. The right methods of handling woodland can be taught with comparative ease, but it is the belief of many investigators that in the past too little stress has been laid upon the financial outcome. Make forestry or agriculture financially attractive and there will be no lack of practitioner. With proper marketing methods, woodlot possibilities in New York are unusually bright. (See Chapter V for detailed advice in relation to marketing.)

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* A Bulletin, Wood-Using Industries of New York, published by The New York State College of Forestry (Series XIV, Number 2, 1913) and the U. S. Forest Service, shows the value of the manufactured product. From these prices (lumber prices have not changed materially since 1913), and the data given in chapter V an idea of the value of timber, standing or in the log, may be obtained.

CHAPTER III

TENDING THE WOODLOT

General

To one familiar with the culture of ordinary field crops the management of a piece of woodland should present few difficulties. The forest produces a crop like any field and trees, reacts to the same factors which control the growth of all plant life. When the crop idea is grasped, the cultural methods used to carry a forest from youth to maturity, are readily understood.

Soil

The site usually occupied by the woodlot is one that is too steep or too stony for tillage or else too sterile for profitable culture. Forestry being based on sound economics insists that each acre within the State be put to its best permanent use, hence, if land is fertile, theoretically the forest should be cleared off and some kind of field crops be raised. However, in the case of the majority of farms in this State, it is not more land which is needed but a more intelligent and more intensive cultivation of the area already cleared.

On account of the modest demands of the tree communities which we call forests, profitable growth may be secured from land entirely too sterile for agriculture, and countless instances proving this statement are available. The pine plains in northern New York, and the sandy stretch of land near Schenectady once supported superb specimens of white pine, and even the most gravelly region of Long Island will grow splendid trees if fires are prevented. Thus, in spite of the large areas of land now classed as "idle land," there is hardly an acre of land above water within the Empire State which will not support tree growth of some kind. *New York has a huge problem of idle, rather than of waste land.**

By suiting the species to the soil these areas can be made productive, although care must be used in the choice of species. Broad-leaved trees, as a rule, demand from one-half to one-quarter the soil fertility which field crops demand, and they,

* Lovejoy. The Segregation of Farm from Forest Land. Journal of Forestry, October, 1919.

in turn, require more than the conifers, which need even less organic matter and salts, and only from one-sixth to one-tenth the moisture needed by hardwood trees. It goes without saying that the soil must be of sufficient depth, although certain species like spruce will grow on shallow soils. Unless the depth of the soil is at least two feet, the trees are liable to suffer considerably from drought and windthrow, or if able to get started on shallow soil, the forest will never properly mature.*

Light

Trees, like all kinds of plants and animals, need light, since light furnishes the energy required for growth. Different species, however, require light in different amounts. Those which are capable of living and growing in comparatively dense shade are known as *Tolerants.* Those requiring nearly full sunlight are *Intolerants,* while between these two extremes may be found a group of trees which we might call *Intermediates.* These are moderate in their demands. Most trees can stand more shade during the first few years of their life, but need more and more light as they mature. The light demands of a given species have an important bearing upon the type of cuttings which they will endure.

Among the tolerant trees, beech, sugar maple, spruce, hemlock and balsam might be mentioned. Intolerants would be represented by such species as hickory, poplar, Scotch pine, Norway pine, tamarack, etc. While some of those classed as intermediate in their light demands would be chestnut, red oak, ash, white pine, etc. The foresters, by regulating the amount of light which reaches the forest floor, can control the species which they desire to reproduce.

Too much light is not desirable, for it is an established fact, that the actual elongation of the stem takes place during the night, and the effects of excess of light in stimulating limb rather than diameter and height growth are well known.

Moisture

Forests, like human beings, find abundant moisture indispensable. In fact, the presence of sufficient moisture in the soil

* The death of large numbers of trees in Central Park, New York City, is largely attributed by the City Forester to insufficient soil depth.

is one of the determining factors of forest distribution. Botanists claim that while extremes of temperature limit the range of forests, north and south, in a large continent, their distribution, east and west, is determined by the amount of moisture available.

Moisture is necessary for the very life of trees, since they take in their plant food in solutions through the delicate root hairs. It is necessary for growth, since 90 per cent of the rapidly growing parts of a tree are composed of water. The water taken in through the roots is combined with the carbon dioxide taken in through the leaves (in the presence of the green chlorophyll in the leaves) to make plant food.

The presence or absence of moisture in the forest soil can be readily detected by the appearance and form of the tree. On moist fertile soils the individuals will be tall and erect, while on the thin, dry slopes of a mountain ridge, the stems will be short or crooked, indicating their need of both food and moisture. On sandy and gravelly locations, trees which thrive on little moisture, like Scotch, Norway (red), or pitch pine will grow. Hickories and black oaks can endure drought comparatively well, but on account of their deeply penetrating root systems, the soil must be comparatively deep if straight stems are to be produced.

The precipitation in New York ranges from thirty-five to forty-two inches per year, an amount ample for excellent tree growth. While a porous or gravelly subsoil, may in certain locations, make the growth of water-needing trees difficult, nevertheless, the moisture supply is adequate for the luxuriant growth of all the valuable species common to this climate and latitude.

Stocking

The woodlot, like every other crop, is judged not only by its quantity but by its quality, and to secure a full stand of trees of the best quality, must be the aim of woodlot management. The quality or desirability of a stand is determined by the closeness or density of the trees standing in the forest. The best quality timber is gathered from tall trees, free from limbs and knots, with slow taper or decrease in diameter from the butt toward the top.

In a dense stand in a woodlot, there is very keen competition between individual trees for light and moisture. Trees in crowded stands are taller than those of the same species and the same age grown in the open. Crowding in young stands, also encourages natural pruning and the development of clear length. In uncrowded stands, not only is the height growth less, but heavy branching is encouraged which is apt to persist, thus lowering the value of the tree. In a woodlot, the trees should be so spaced, so that the crown of each individual is in contact with that of its neighbors. A well crowded stand produces a larger number of clear, knot-free, high quality saw logs, than does an open stand of the same area. This is vitally important, and bears a direct relation to the financial returns to be expected from the woodlot. The price of logs of first quality is usually from one to two times as much as that paid for logs of poor quality.

The approximate number of trees which should be present on a single acre is shown in the following table. The figures are applicable to oak, aspen, hickory, elm and ash, but are from 15 to 20 per cent too low for maple, basswood, yellow birch, beech, white pine and red pine.

TABLE I[1]

NUMBER OF TREES WHICH SHOULD BE PRESENT PER ACRE[2]

DIAMETER[3]	WHEN DIAMETER OF TREES RANGES FROM				When trees are all of a uniform diameter
	2 to 10 inches	2 to 14 inches	6 to 18 inches	10 to 24 inches	
Inches	Trees [4]	Trees [4]	Trees [4]	Trees [4]	Trees [4]
2	400	300	....	....	2,000
4	180	130	....	....	900
6	105	75	75	....	510
8	65	45	45	....	320
10	50	30	30	30	235
12	....	25	25	20	170
14	....	20	20	16	130
16	....	....	15	12	100
18	....	....	12	11	85
20	....	....	....	9	75
22	....	....	....	8	65
24	....	....	....	7	55
Total per acre	800	625	222	113	.....

[1] Data taken from Department of Agriculture Bulletin No. 711.
[2] Data furnished by Prof. E. L. Sponsler, University of Michigan.
[3] Diameters taken at four and one-half feet from the ground.
[4] Of the respective diameters indicated in the first column.

From the foregoing, it may be seen, that each acre of ground during a single season receives a certain amount of growing energy in the form of soil fertility, moisture and light; the latter two vary somewhat from season to season, but for a given latitude and climate, the amount of growing energy, heat, light, moisture and plant food available for each acre, will remain nearly the same. (It is true, however, that a surplus of food, for instance, may compensate for lack of light, so that on moist, fertile sites, trees may endure more shade — that is, exhibit increased tolerance — than on less favorable places). With a constant amount of energy at hand, it is the forester's aim to confine this growth to a few hundred chosen trees of desirable form and species, rather than permit it to be divided among many hundred trees per acre, many of which should be considered forest weeds. This idea will explain the theory of improvement cuttings.

Important New York Trees

From the standpoint of marketing the product, some species are much to be preferred to others. White oak and black cherry, for instance, have now a greater market value than basswood or elm. Too much dependence should not be placed on market prices for lumber, but rather the effort should be made to grow timber best adapted to each particular soil, situation and locality. That is, endeavor should be actively made to adjust the management of the species to be favored with the best or local markets for woodland products. Following is a list and brief description of the more important species native to the State:

1. The Softwoods:

   White pine (*Pinus strobus*). The range of white pine is general all through New York State, but it occurred in greatest abundance throughout the Hudson valley, and in the sand soil north from Schenectady through to Lake Champlain. Except on state lands, there is very little virgin white pine standing in the State, the greater part of it being second growth. Early sawmills in the State cut little else. The tree is fast growing, being perhaps the fastest of native trees. In virgin stands, it grows tall, full boled and

free from limbs for many feet from the ground. The wood is of superior quality, being light, soft, compact, straight grained, easily worked, and is in high demand for box boards, patterns, interior trim, window sashes and doors.

Red spruce (*Picea rubrum*). This tree is one of the most valuable trees in the State throughout its range. It is a northern tree, and is found abundantly throughout the Adirondack region and northern New York, and at the higher elevations of the Catskills. It prefers cool, damp situations with plenty of moisture in the surface layers of the soil. The wood is light, soft, lustrous and very strong for its weight. On account of its color and long fibre, the wood is very much in demand for paper pulp. It is also in demand by woodworking concerns for interior and outside trim, sashes and doors. On account of its qualities of resonance, spruce is also in great demand for the sounding boards of pianos, violins and other musical instruments.

Hemlock (*Tsuga canadensis*). Hemlock is common all through New York State in cool, well-drained situations. It is a tree which endures shade extremely well. Given advantage in full sunlight from its youth, it will show more rapid growth than spruce or red pine, but once accustomed to the shade, it will wither and die on sudden exposure to sunlight through the removal of surrounding trees. The wood is brittle, coarse grained and splintery. It is, however, in great demand for paper pulp, house construction, boxes and crates and rough furniture.

Balsam fir (*Abies balsamea*). Balsam fir is restricted to the Adirondack region and northern New York. A rather symmetrical looking tree, with a rapidly tapering bole, it is mostly confined to swamps and low flats where there is a surplus of soil moisture. The wood is soft, light, weak and perishable in contact with the soil. It is used mainly for paper pulp, rough construction, boxes and crating.

White cedar (*Thuya occidentalis*). This is a swamp species of conifer. It has a symmetrical, conical form, but very little clear length, and is very limby. The wood is

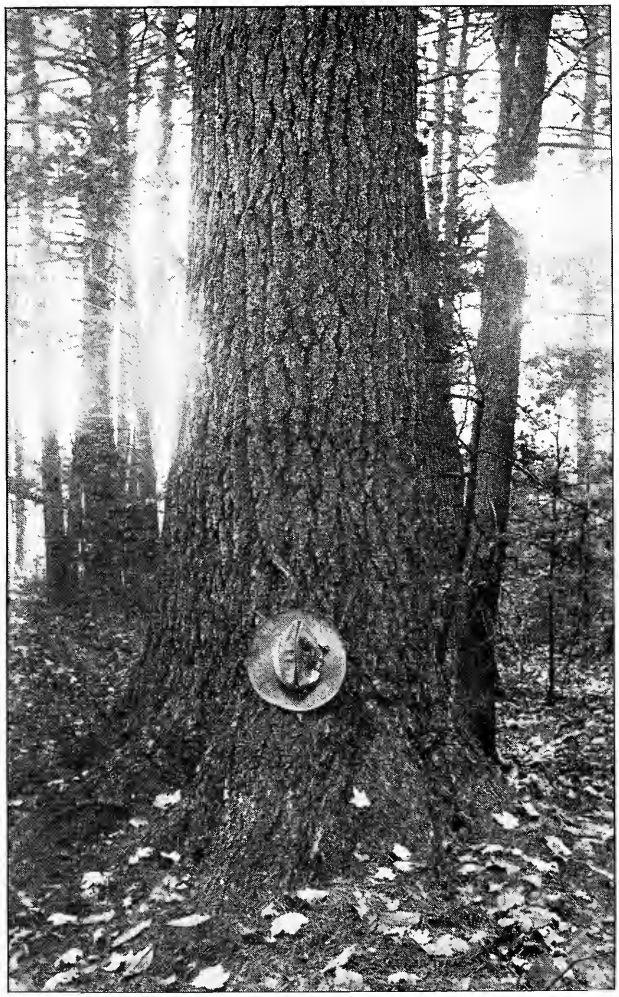

FIGURE 2. FIRST GROWTH WHITE PINE. With the exception of the tulip tree, the white pine is the largest tree in the eastern forests. Specimens have been found having a diameter of six feet and a height of 250 feet.

harsh, coarse and weak, but it is very durable in the soil. Its chief use so far as the farmer is concerned is for fence posts and fencing, and hence on its own site is a very valuable species on the farm.

Red cedar (*Juniperus virginiana*). This tree occurs scattered throughout old fields and abandoned pastures. It is an upland species of cedar as contrasted to the one preceding. Its growth is very slow, and it does not attain any size. Its chief use is for posts and fencing, although superior grades of it command a good price for pencil wood, cabinets and chests.

2. The Hardwoods:

White oak (*Quercus alba*). A large, symmetrical and beautiful tree which grows to great age and size. It prefers deep soils, moderately moist and fertile. The wood is very heavy, hard, tough and durable. On account of its ability to take a high polish, and the natural beauty of the wood, its main use is for high grade furniture of all kinds. It is also used for interior finish, flooring, car construction and vehicle parts.

Red oak (*Quercus rubra*). This tree on favorable situations produces a long, regular, full, straight bole with a wide spreading crown. It prefers rich, deep, porous, well-drained soils. It will not exist on clay soils, and on shallow soils is apt to be stunted and of poor form. The wood is one of the softest, lightest and easiest to work of the oaks. It is one of the fastest growing of the oaks, and is a very desirable tree to encourage in woodlot management. It is used mainly in car construction, furniture, flooring and planing mill products.

Black oak (*Quercus velutina*). This tree develops a straighter bole with moderate taper, but shows a tendency to fork a short distance from the ground. It is less choice in its soil and moisture conditions than other oaks, and will grow on all except heavy clays with poor drainage. The wood is heavy and coarse, subject to knots and imperfections, but is fairly durable. The wood, however, seems

more susceptible to boring insects than does that of other oaks. The growth is slower than red oak, about the same as for white oak. It seems to be a less desirable tree to encourage than either red or white oak, except on the dryer upland sites. The wood is used mainly for car construction and for agricultural implements.

Chestnut (*Castanea dentata*). On account of the bark disease chestnut seems to be a doomed tree all through New York State, and does not seem to be one to be encouraged in woods management. Expert opinion seems to favor the removal of the chestnut and the encouragement of some more desirable species. It is a rapid growing tree of good form on all soils except swamps and heavy lime soils. The wood is light, soft, easily worked, rich in tannin and very durable in the soil. The wood is mainly used for dairymen's supplies, construction, furniture and the production of tannin extract for the leather industry.

Hard maple (*Acer saccharum*). In full stands this tree develops a long, straight, clear bole of moderate taper, and a full, symmetrical crown. It grows best on moderate slopes with a deep, well drained clay or lime loam with abundant humus and moisture in the surface layers. This tree is also called "sugar maple," because of its use in the production of maple sugar. Because of the value of this product a growth of sugar maples, in a grove or sugar bush, is to be encouraged as a very valuable and productive adjunct of any farm. The wood is very heavy, hard and of good texture and quality. It is used mainly for boot and shoe lasts, flooring, interior finish, musical instruments and furniture.

Red maple (*Acer rubrum*). This is a very inferior tree to the preceding. It is to be encouraged over the former mainly in swampy situations subject to periods of inundation too moist for the hard maple. The wood is coarse, moderately hard and is used mainly in rough construction and for fuel. A greater use of wood fuel on the farms is to be expected in the future than has characterized the immediate past. And the encouragement of this

FIGURE 3. SUGAR BUSH IN SPRING TIME. Since colonial time the hard maple or "sugar tree" yielded large quantities of sugar. The early settlers followed the custom of the Indians in sugaring off the sweet sap.

species on its own site for this purpose would be a matter of good business sagacity and common sense.

Yellow birch (*Betula lutea*). This tree is very generally distributed throughout New York State, but reaches its best development in the forests of the Adirondacks and northern New York. It rarely grows pure but occurs in mixtures with spruce, balsam, black cherry, sugar maple and beech. It is a very well proportioned tree, with a full, clear bole and a spreading crown. It is very exacting as to soil conditions. It prefers moist uplands with plenty of soil moisture in the surface layers. The wood is heavy, hard, strong and of good quality. The wood is used mainly for flooring, interior trim, furniture and vehicle and implement parts.

Beech (*Fagus americana*). This is a strikingly beautiful tree because of its grayish bark and its symmetrically spreading crown. It occurs in mixed woods in association with other trees. It is the most tolerant, or shade-enduring hardwood, of the northern forest. It occurs generally all over the State, but reaches its best development in the Catskills, and in northern New York. It will grow on most any soil retentive of moisture in the surface layers, but does best on rich deep soils of clayey or loamy texture. The wood is hard, tough and strong, but very perishable. Along with yellow birch and sugar maple it is a very desirable wood for railroad ties, but like them, also, must be treated with a wood preservative against decay. The wood is used mainly in flooring, interior trim, furniture, handle stock, boxes and crates.

Basswood (*Tilia americana*). This tree, while it occurs rather generally all over the State, is more or less of a fugitive tree, occurring scattered in stands or mixtures with other species. It is not a tree to be encouraged in woodlot management, except as it occurs naturally. It grows best in moist situations, over deep, well drained, fertile soil. The wood is light, soft, tough, close grained and easily worked. It is much used for barrel heading, loose cooperage, planing mill products, furniture and excelsior.

Butternut (*Juglans cinerea*). In New York State this tree is most abundantly found in the lowland hardwood forest in the southern and western parts of the state. The tree grows under a wide variety of soil conditions, but only on deep fertile soils is it of consequence as a tree. On very good soil the bole is long and straight with little taper, but on poorer sites, it is apt to be forked very near the ground and be otherwise defective. It is extreme in its light demanding requirements. As an object of management the tree should only be regarded as a nurse for the development of a more tolerant understory.

Rock elm (*Ulmus thomasi*). This is the only elm in which the main stem extends up through the crown. The tree is a large, well-formed tree with a narrow open crown and a full bole, much buttressed at the ground. It prefers dry, gravelly soils of ridges and glacial eskers, where it is often found in mixture with beech, birch, maple, and ash. It is very intolerant (i. e., light demanding) and on this account, and also on account of its slow growth, in competition with other trees, it is often driven to the drier, poorer sites. The wood is very close-grained, heavy, hard, strong and of high technical value, and is in much demand for agricultural machinery, where strength and resistance to shear are prime requisites.

Hickory (*Hicoria ovata*). Shagbark hickory is the most common and most widely distributed of all the hickories. Under favorable conditions it develops a clear, full bole, with a short, spreading, round-topped crown. The tree is found on a variety of soils, but prefers the fresh fertile soils of bottom lands, which have an undoubted clay constituency. The growth is comparatively slow, and inasmuch as it is the most tolerant of all the hickories it will withstand considerable competition in mixture with other hardwoods such as oak, basswood and maple. The wood is very heavy, hard, close-grained and tough. On account of its great resistance to bending the wood is in great demand for handle stock for implements.

White ash (*Fraxinus americana*). Both white and black ash grow throughout the state, occurring as scattered individuals in moist situations.

These trees are not very shade-enduring, and throughout the sprout hardwood region the white ash, through competition with more tolerant trees, is often driven out of its favorite sites on to the drier but less crowded situations on the uplands. Ash on its own site is a rapidly growing tree, developing a tall straight, full bole and a good crown. The wood is heavy, hard, easy to split, tough and flexible. It is much in demand for vehicle parts and for handle stock where resistance to bending is a requisite. It is also used for furniture, planing mill products and for agricultural implements.

Other trees which might be mentioned are Black walnut (*Juglans nigra*), Black cherry (*Prunus serotina*), Elm (*Ulmus americana*), and Tulip poplar (*Liriodendron tulipifera*). Because, however, of their scattered and fugitive character, they are never to be considered a direct object of woodlot management.

A fuller list of the various uses of our main New York State species will be found listed in the Appendix, pages 155–164. Before management of the woodlot is undertaken this list should be consulted so as to adjust the management of the species to be favored with the best or local market for woodland products.

Desirability of Different Species

As far as farm woodlot management is concerned, the value of different species as the one or ones to be favored depends principally upon their comparative rates of growth and yields per tree and per acre, and the value of money to be received for the wood material after it is cut, both for use on the farm itself and for sale.

White pine seems to be the most desirable species to favor among the conifers and red oak among the hardwoods. Both of these trees exhibit on good soils a quick and rapid growth, and the returns from their management will be found very profitable. On the best soils in favorable situations there are other species which make rapid growth and should be favored where the opportunity offers. These species are white ash, basswood, tulip poplar, black cherry and red pine. On comparatively poor situations, only the hardier species of pine and oak

will survive. Chestnut should rank as a highly desirable species, but on account of the blight disease is not a species to be favored in management. In the Adirondacks and the northern New York region, white pine and spruce will remain the trees to be favored, with the hardwoods beech, yellow birch and hard maple on the drier upland sites.

Growth

The comparative rates of diameter growth of the most important of our New York species would be about as follows:

TABLE II[1]

Average number of years to grow one inch in diameter[2]	Species
3 to 4 years	Yellow poplar.
3 to 5 years	Chestnut.
4 to 7 years	Black walnut, white pine, red pine, white ash, red oak, black oak, aspen.
6 to 9 years	Hickory, white oak, basswood, paper birch.
8 to 10 years	Red spruce (second growth).
9 to 18 years	Hard maple, yellow birch, beech, white elm, hemlock, balsam fir.
18 to 25 years	Arborvitae.

[1] Table is based on growth of trees in natural unmanaged stands. Under proper management, much more rapid growth can be secured, particularly of those species in the last four lines.

[2] Table taken from Department of Agriculture Bulletin No. 711.

It will at once be seen that the slower growing species with their long time growing period to merchantable size, from an investment standpoint, should not be favored in woodlot management.

Height growth and diameter growth should be taken into consideration together. It is very important that trees should be tall and well formed in proportion to their diameter. Reference to the following table will show about the proper relation that should exist between the diameter and height of the different species at different ages:

TABLE III

AVERAGE GROWTH OF VARIOUS IMPORTANT SPECIES IN NEW YORK STATE[1]

SPECIES	AGE									
	20 years		40 years		60 years		80 years		100 years	
	D.B.H.[2]	Height	D.B.H.[2]	Height	D.B.H.[2]	Height	D.B.H.[2]	Height	D.B.H.[2]	Height
Aspen	2.4–5.3	17–40	4.7–10.4	37–66	7.0–14.8	57–81	9.3–19.2	64–87	.....	.....
Arborvitae	0.5–0.7	4–8	1.4– 1.6	12–13	2.8	18	4.2	25	6.2	32
Ash, white	4.5–8.2	34–52	9.4–15.3	57–75	13.1–19.6	71–81	16.5–22.8	81–83	.....	.....
Balsam fir	1.0–1.3	14–22	2.8– 4.0	27–45	4.9– 6.5	36–61	6.5– 8.2	43–69	7.6– 9.5	48–73
Beech	1.0	10–16	2.0	18–30	3.1	26–41	4.6	33–52	6.4	41–61
Birch, yellow	1.8	14–22	3.5	24–40	5.4	33–53	7.4	39–64	9.4	46–74
Chestnut	4.9	14–22	9.4	.....	11.4	.....	12.9	.....	.....	.....
Elm, white	3.6–5.9	24–39	6.6–10.6	35–57	9.2–14.2	45–66	.....	.....	.....	.....
Hemlock	0.4–1.5	7–17	1.4– 4.4	13–39	2.5– 7.4	20–58	4.0–10.5	28–73	5.5–13.8	36–84
Hickory	3.6	.....	7.1	.....	10.0	.....	.....	.....	.....	.....
Maple, hard	1.3	12–26	2.7	23–46	4.3	32–58	6.0	41–68	7.8	48–76
Oak, red (sprouts)	4.1	.....	8.0	.....	.....	.....	.....	.....	.....	.....
Oak, white (sprouts)	3.9	.....	6.6	.....	8.4	.....	.....	.....	.....	.....
Pine, white	7.0–7.4	26–27	11.8–13.6	52–55	.....	.....	.....	.....	.....	.....
Spruce, red	0.3	5	1.1	8.0	2.0	12.0	3.2	18.0	4.4	27

[1] Data taken from Department of Agriculture Bulletin No 711.

[2] D.B.H., Diameter Breast High, taken outside the bark at a point four and one-half feet above the ground.

Appearance of Individual Trees

Not only should the individual trees show good diameter and height growth, but their trunks should be free from limbs except near the top. Where a tree is forked near the ground its value is very greatly reduced. It is also important that the trunks should be sound and free from insect borings and fungus decay, both of which greatly reduce the value of the lumber, and may, if badly infected, make the tree utterly useless. No insect-infected or diseased timber should be allowed to stand, and it is a matter of simple silvicultural hygiene to remove such individuals as soon as infection is noted.

Soil Conditions

In a well-managed, properly-spaced, well-growing woodlot very little sunlight should be allowed to strike the ground. Sunlight itself causes the ground to dry out and encourages the growth of grass and weeds. In a well-shaded woodlot there is formed over the surface layers of the soil a rich mulch of decayed and semi-decayed organic matter, derived from the fallen leaves and twigs, which has a very beneficial effect upon the growth and condition of the woodlot. Where grass may have started, it should be killed out by increasing the crown cover and shading it out. It should never be killed by pasturing.

Pasturing the woodlot becomes the chief of chief causes of its deterioration. The severity of the damage depends upon the size of the woodlot and the number of stock. One characteristic of a pastured woodlot is its complete, or almost complete, absence of young growth. The browsing of cattle and hogs quickly means the vanishing of natural reproduction. The older trees suffer through wounding and the tramping in of their roots, and by the compacting of the soil by the hoofs of the stock to a condition where it is absolutely impervious to water and water penetration. Only where it is desired to clear the woodlot of some brush of undesirable species should cattle be allowed to run.

It is not possible to secure a growth of timber from a woodlot and at the same time utilize it for pasture. Grass in a woodlot is an almost infallible sign of mistreatment somewhere. Grass will not thrive without direct sunlight, and it is only to a lim-

ited extent that such light reaches the forest floor in a woodlot. Pasturage and timber production cannot be carried out on the same area, except to the mutual disadvantage of each, and they can never be carried out profitably together. The advantage of providing shade for stock is without question. Where that is necessary a small corner of the woodlot adjacent to the pasture land should be fenced off for that purpose only, while the remainder can be more profitably devoted to the production of timber alone.

Life History of a Forest

In order that the growth and development of a forest community may be clearly understood, its life history will be traced from the beginning. In the majority of cases the farm woodlot represents a piece of *mature* timberland that has been cut over again and again, but it will be easier to understand the whole cycle, if a start is made with an open field.

When the early colonists commenced to push out in all directions from Plymouth and the coast of New England, things other than soil fertility were in their minds. Accessibility to existing settlements, safety from Indian attacks, etc., were paramount; consequently their choice of farm homesteads were not particularly happy. To-day, New England is dotted with small villages located on ridge and mountain tops, where the soil is thin and drainage excessive, whose population is now but a fraction of what it was fifty or seventy-five years ago. It is in such situations as these that the abandoned fields and pastures are most numerous, the early tillers of the soil having given up their job with their life, and the next generation seeking an easier existence in the nearby town or larger city, leaving the fields and pastures to become covered with woody growth.

Picture then a pasture from which the grazing sheep and cattle have long since disappeared, or a field abandoned after tilling. A nearby forest located on the uncleared hill-top furnishes wind-blown tree seed of all kinds. Besides, the birds assist in bringing in from a distance seeds of berries, shrubs and of some trees. A few years after the land has been abandoned, a heavy growth of ferns, raspberry or blueberry bushes will have seized the soil, and here and there an occasional bird-

cherry, poplar, gray birch and pine seedling will appear. As the years pass, the number of trees per acre increases, gradually shading out the low shrubs, the kind depending upon the nature of the soil and its fitness as a germination bed for the more common species available. If located in a natural pine country, sandy soils will permit the ready germination and rapid growth of the young pine seedlings, and in parts of New England and New York, pine trees appear in neglected fields with amazing rapidity.

At first, each tree has an abundance of room; in fact, there may be holes of considerable size where no trees are found. These holes are filled during successive seed years, and in the course of ten to fifteen years, in a natural pine country, the open areas will be completely covered with seedlings of different sizes.

As they develop, the lower limbs interlace. The leaves on these branches die from lack of sunlight. The grass and flowering shrubs disappear from beneath the trees, and the earth becomes covered with a carpet of needles. Each tree is putting forth its best efforts to attain superior height, for in the early years of a forest, the race is certainly to the swift. A few trees, small and stunted from the beginning, or those whose seed "fell upon a stony ground," lag behind. They are soon over-topped and soon die from lack of light, or in their weakened condition, fall prey to insects or fungus disease.

As the years pass, tree classes are formed. In the place of 10,000 trees per acre, all having approximately the same size, the numbers have decreased at the end of twenty years, to say, 1,000. These are tall, dark, green and thrifty, with long intervals between their whorls of branches, showing that their rapid height growth was responsible for their survival. The lower branches no longer reach down to the ground as wind and sleet storms have whipped off the dead interlacing branches, and already the branch scars have almost disappeared. (In case the trees stood too far apart, these lower branches would persist, and limby trees yielding extremely knotted lumber would result). In a few years more, there will be a marked forest canopy, a forest floor carpeted with dry, brown needles, dotted here and there with grasses and shrubs, where filtered light has

FIGURE 4. SECOND GROWTH HARDWOODS FOREST IN THE SAPLING STAGE. Ordinarily the forester allows the trees to fight their own battle until they are large enough to pay the cost of removal. In especial cases "cleanings" may be made.

permitted their development. The forest as a community has appeared.

From about the fortieth year on, the struggle is not so keen, as the period of most rapid height growth has passed. Natural pruning continues as the lower branches keep dying off and the clear lumber is being laid on around the rather knotty heart. Diameter growth now becomes more marked, since during the earlier part of their life, the trees were more concerned with keeping their heads above the forest level. An occasional member of the forest community disappears from one of the many causes. Lightning, wind storms, insect or fungus attacks all take their toll, but the gap in the forest canopy is soon closed up by the comparatively young and thrifty trees.

A time comes, however, when the forest is no longer young. The trunks are now tall, ninety to one hundred ten feet, full boled, from two to three feet in diameter, with a stretch of from fifty to sixty-five feet to the first large limb (clear length). Deaths are more numerous at this time, and a hole in the canopy is no longer filled, as the crowns can not easily spread to fill up the vacant spaces.

Instead of a dark forest carpeted only with needles, grasses and herbs are quite numerous, and occasional clumps of seedlings are found beneath the openings in the canopy.

This period, called "silvicultural maturity," when the forest begins to perpetuate itself upon the ground beneath, marks the beginning of the end. Some of the veterans fall, and many prostrate trunks are seen covered with moss and in varied stages of decay. The groups of seedlings increase in size and height, owing to the widening of the circle by the fall of some of the surrounding trees. Soon the forest consists of groups of young trees whose edges meet, and towering above are the remnants of the former generation. This is the epic of the forest, and the land once clear and pastured is again in possession of the forest, to all appearances primeval.

Forest Protection

Owing to natural agencies, a certain number of losses in the members comprising the forest community are unavoidable, and in fact, desirable. However, it should be the aim of woodlot

owners to reduce such losses to a minimum, and the losses should be confined to such species whose removal will benefit the composition and growth of the stand. Certain agencies, while not actually killing the trees, may impair the general health of the forest community in such a way as to diminish the growth and render it subject to other insidious attacks which may cause the death of many of the individual trees, both mature and juvenile.

Fire

Of all the enemies of the forest, fire is the most destructive and at the same time should be the most easily prevented. In forest regions far from settlements, a fire started by lightning or the camp fire of a hunter or fisherman may rage for hours and even days unnoticed. In the average farm woodlot, its detection is easy, and its suppression should be immediate. The average annual loss to standing timber due to fire in the United States approximates $50,000,000, and it is a safe deduction that a measurable part of this loss is sustained by the woodlot or small forest owner. The chief causes of this loss to the farmer are the carelessness of the general public, and, his own ignorance regarding the actual amount of damage which even a light ground fire does.

Fire Damage

The general attitude in the past has been that, unless mature trees are killed, the forest has come through practically unscathed. This is far from true. Even though the large trees may not die at once, the cambium structure, which produces the annual layer of wood, may be badly scorched at the base of the tree. Several years later the bark may come off exposing the burned portion to agencies of disease and decay. In fact many a serious outbreak of a severe fungus attack may be traced to a severe fire some years previous which apparently did no damage at the time.

Assuming that the spring or autumn has been comparatively moist, and the only inflammable material has been the surface layer of leaves, is there any harm in letting a forest fire run unchecked? Indeed there is! In the first place, practically all

FIGURE 5. ABANDONED WOOD ROAD IN SECOND GROWTH FOREST, HUDSON HIGHLANDS. By cleaning out old roads and trails as fire lines, the safety of forest property can be vastly increased.

the seedlings under several feet in height will be killed, as their bark is not yet thick nor corky enough to withstand the heat. All seed which has been lying in the litter and in the top layers of soil will be destroyed. These two effects are extremely serious, since the coming generation has been wiped out of the community. In addition, unless the soil be very damp, a large portion of the humus, that dark layer of decomposed leaves and twigs, containing the stored-up nourishment of many years—will be burned up, and its richness will be washed away by the melting snows and the next heavy shower.

These indirect losses are hard to measure, yet their results are clearly appreciable in the form of diminishing numbers, increased disease, decreased growth and ultimately a smaller cash income. No matter if a woodlot has been burned over one or more times, fires should be religiously kept out, as each one adds to the damage, especially in rendering the soil unfertile and compact and thereby making the new growth extremely difficult, to say nothing of tremendously reducing the water-holding capacity of the forest cover. On account of its relatively small size and its usual proximity to habitations, farm woodlots can be well protected against serious fire damage. The smoke is quickly seen and sufficient help to fight the fire can ordinarily be secured.

If every member of the rural and forest communities of the State would endeavor to exercise unusual care in the prevention of forest fires and then prompt suppression, if started, this phase of forest injury would be markedly decreased.

*Insects**

The damage inflicted by insects upon small forest properties seems slight, as a rule, especially when compared with injury sustained by field and orchard crops. However, in the aggregate the loss is heavy. A careful watch should be kept in order that no dangerous insects are allowed to ravage the forest unchecked, as it has been the rule that the most severe insect

* For a full description of the most important insects and their remedies, see Bulletin XVI, No. 26, of the New York State College of Forestry, "Some Insect Enemies of Shade Trees and Ornamental Shrubs," by Dr. M. W. Blackman and W. S. Ellis.

depredations in this country could have been controlled with comparatively little effect at the outset.* Consequently, a few of the more important insects will be briefly mentioned, and simple remedies given for their control. These remedies may be used to protect single trees or small groups, but in many cases the measures taken by a single owner will do little good in case of a state or county-wide insect invasion. However, every forest land-owner should have a general idea of the insect problems which threaten the forests of our State.

The damage inflicted by insects upon forest and shade trees consists of six kinds:

1. Eating the leaves.
2. Sucking the sap.
3. Boring into the wood and girdling the tree.
4. Splitting the twigs, etc., while placing the eggs.
5. Producing galls.
6. Attacking fruits, nuts, etc., thus injuring reproduction.

In each case a different form of attack is necessary to combat their efforts.

Leaf-eating insects. Among the insects which prey upon forest and shade trees and inflict damage or even kill by several defoliations, the following may be prominently mentioned:

The forest tent caterpillar.
The elm leaf beetle.
The gypsy moth.
The brown tail moth.

The two latter insect pests have not yet gained a permanent foothold in this State, but the seriousness of the moth problem throughout all New England makes a future attack extremely probable.

In Massachusetts, large estate owners are compelled to spray most carefully each season, and it is only as a result of a well-conducted campaign carried on by the Federal and State gov-

* Woodlot owners may send specimens of forest insects and their work to the New York State College of Forestry at Syracuse. Only in this way can accurate advice be given regarding the best methods of control.

ernments, cooperating with the private forest owners, that the gypsy and brown tail moth attacks have been kept in check. It is estimated that in Massachusetts alone over $1,000,000 is spent each year for moth prevention work.

Remedies. Any insects which feed upon the leaves of a tree may be destroyed by a poison spray—arsenate of lead 3½ pounds to 50 gallons of water being the usual strength. The spraying of entire woodlots is hardly practicable except in cases of gypsy and brown tail moth infestation mentioned above, where it is necessary to prevent further spread.

Sap-sucking insects. Other insect enemies damage the members of the forest community by sucking the sap, thereby diminishing its growth and lowering resistance, or if present in sufficient numbers, they may kill the trees—the woolly aphis often attacking the young and tender shoots of the white pine, the San José and oyster shell scales, etc.

Such insects may best be controlled by the use of contact sprays like whale oil soap emulsion* or "Black Leaf 40"—one part to 800 to 1,000 of water. On small trees these solutions can be applied by shaking the solution upon the infested portions of the tree by means of an old whisk broom.

Borers.—Still other insects damage shade and forest trees by depositing eggs in the succulent parts of the tree, and after hatching the grubs, bore channels around the trunk or in the young limbs causing the disfigurement, if not the death of that part, or the entire tree, due to girdling (cutting off the circulation). Among examples of such insects may be mentioned the white pine weevil attacking the growing shoot (leader) of the young and thrifty white pine—the maple sugar borer, the hickory bark beetle, the bronze birch borer, the hemlock borer, etc.

In practically all of the cases where the borer is present, it is too late for any good remedy. Good forest hygiene is the best protective measure—the removal of trees which are of lowered vitality—while those which are already infected should be removed at the proper time to accomplish the destruction of the

* See Bulletin XVI, No. 26, The New York State College of Forestry, p. 116.

larvæ. In some cases, as with a light attack of the maple borer, single trees may be saved, by squirting carbon bisulpide in the hole and then plugging it up with putty. Or, the grubs may be killed by inserting a fine copper wire in the hole, or sometimes by cutting out the burrow until the grub is found and destroyed.

In the case of the white pine weevil, considerable damage is often inflicted upon the growing shoot or leader of pines in open, pure stands. During June and July, many of these leaders may be noticed in a wilted condition, and later turn quite brown. On being cut longitudinally, many channels are noticed. Entomologists recommend the cutting out of these wilted leaders during the months of June and July, and collecting them in a barrel covered with a finely meshed, screened top. This method will permit the small parasites which often infect the larvæ to escape and later prey upon the coming generation of weevils, while the beetles (white pine weevils) themselves will be kept confined and die.*

Fungus Diseases

The effect of fungi within the forest is not entirely bad. Bray has brought out the fact (*loco cit*) that if it were not for the activity of fungi and bacteria, there would be a vast accumulation of dead but undecomposed material lying upon the earth's surface which would render life impossible.

Such fungi are for the most part saprophytic, and live upon the material already dead. The real damage is accomplished by the parasitic fungi which attack living trees.

The remedy for attacks of the bracket fungi, which often attack stands of grey birch and poplar, is to cut and remove the diseased trees as soon as possible. In fact, practically all fungus diseases may be kept in check by this means—keeping the forest clean. However, the trees when cut should not be piled in or near the forest, as the spores from the infected trees may be carried by the wind into a crack in the bark of some fine tree only to start its attack afresh. All damaged material should

* See pp. 45–90, Bulletin XVI, New York State College of Forestry, for preventive measures against boring insects.

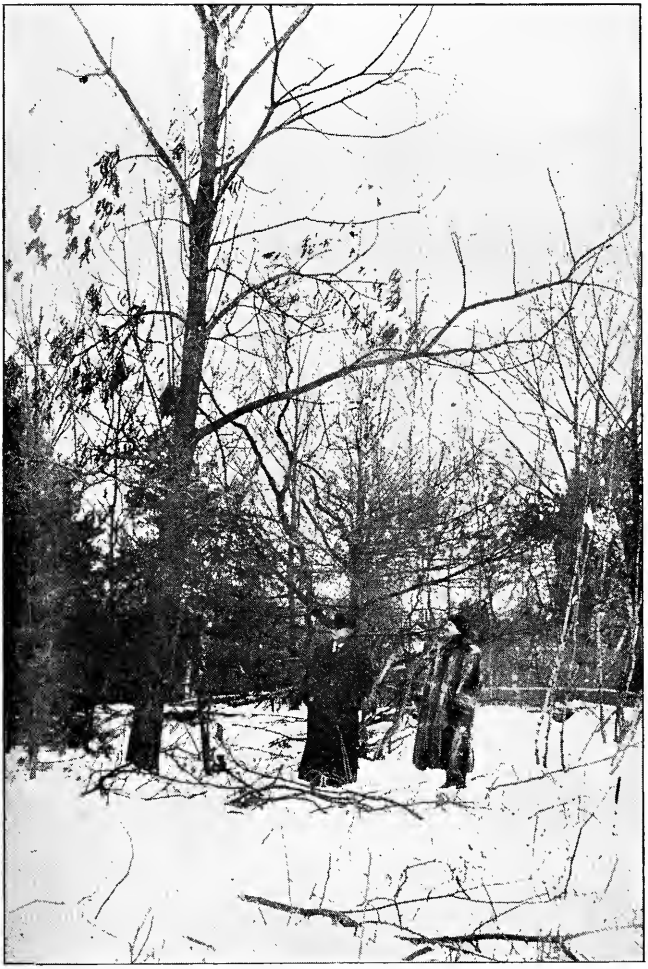

FIGURE 6. A CHESTNUT TREE KILLED BY THE BLIGHT. This fungus disease, introduced from China, has practically exterminated the chestnut as a forest tree throughout the northeastern United States.

be removed from the vicinity of forest growth and utilized or burned immediately.

Of the fungus diseases now attacking the forests in New York State, two are by far the most dangerous: the chestnut blight and the white pine blister rust. The former fungus attacks the inner bark of the native chestnut, and ultimately causes death by girdling the tree. It is a native of China, while the latter was introduced into this country from Germany upon planting stock used for reforestation purposes.

The chestnut blight was discovered in New York City in 1904, and has displayed the greatest virulence. Already it has killed practically all of the chestnut trees throughout New England, Long Island, and in the lower Hudson Valley. While it seems to be abating somewhat in its spread and the vigor of its attacks, nevertheless the outlook for this valuable species is extremely dark.

In many parts of this country, notably in Pennsylvania, where a sum of $275,000 was appropriated to combat this disease, strenuous efforts were made to prevent its spread but with little success. Effort was made by repeated cuttings, followed by burning all the infected bark, etc., to control it, but in vain. New infection followed, and the disease continued to advance until it appears that the chestnut is doomed, since the wide spread of the disease, the profusion of spores produced, and the ease with which they are disseminated, makes any method of suppression practically impossible.

In the case of the white pine blister rust, while the sudden outbreak of what was thought a complete eradication is alarming, nevertheless its method of life offers some hope of extermination, if vigorous methods are taken immediately. The spores of the blister rust upon the pine cannot infect another pine, but must find lodgment upon a currant or gooseberry bush, where they pass the second phase of their existence. From the currant or gooseberry they reinfect the nearby pine, and so the cycle continues. By inspecting plantations of young pine growth in regions where infected material was used, by burning all infected trees, and removing host plants of currant and gooseberry within a radius of from 400 to 500 feet from such a plantation, it is hoped to suppress this serious disease. When

it is realized that the white pine of New York are worth millions of dollars, some conception of the problem may be had. The federal government is cooperating with the various Eastern states, but only by the most vigorous measures, and by the heartiest cooperation between the federal and State governments and private individuals, can this serious disease be suppressed.

Grazing

The typical woodlot in New York is considered as an adjunct to the pasture, and the average owner can see no harm in allowing his cattle to run in the woodland. As previously mentioned, horses and cattle nibble the young seedlings and trample down hundreds that they do not bite; in addition, they render the soil too compact for easy germination, as the tiny rootlets of the sprouting seed can only penetrate mellow soil.

While it is true that under certain circumstances (a mature forest in which regeneration is not immediately needed) pasturing does little damage, nevertheless, it is undoubtedly true that the same piece of soil cannot be made to serve two purposes. If additional pasture is needed, and some of the land covered by forest is fertile enough to grow good forage, remove the trees and sow grass, for as a rule the pasturage produced beneath forest shade has little nutritive value. Good timber and good grass cannot be grown on the same acre.

Wind, Snow and Ice

The elements in some cases cause considerable injury to the farm woodlot, but as a rule, any large damage is rare. A violent storm may break off limbs or tops and in rare cases uproot shallow-rooted trees. A heavy snow or sleet storm may break off branches or badly bend and deform young seedlings, but in most cases they will soon recover unaided. To avoid such damage on exposed situations, cuttings should be made quite light, and, as a rule, it is wise in planting or in management to mix windfirm species with those that are shallow-rooted and subject to windthrow. In Germany it is customary to plant a wind mantle or shelter belt to protect such plantations or stands.

In general it may be said that a certain percentage of loss in a forest community is unavoidable, but it should be the aim of

every landowner to keep this loss at a minimum by the exercise of reasonable care and that at a moderate cost. Extremely intensive measures which are practiced by owners of country estates may not be economic and should really be charged up to landscape improvement rather than to forest protection and maintenance.

Starting the Woodlot

Upon the majority of farms in New York there is some land already covered with forest growth so that the problem to be solved is improving the existing woodlot and making it productive and profitable rather than commencing with an open field or abandoned pasture.

Natural Regeneration

Forests reproduce themselves naturally by seeds and by sprouts, but proper conditions must be maintained to permit them to carry out these natural functions.

None of the evergreens native to this state reproduce by sprouting, but practically all of the hardwoods sprout during their youth, although some seem to lose this habit as they grow older. Species like chestnut, maple, the oaks, basswood, etc., sprout very well, and to reproduce a forest composed of such species is comparatively easy, since a clear cutting, provided it has not been deferred until a great age,* will result in a thick stand of sprouts coming up from the stumps. Repeated cuttings of sprout forests, called "coppicing," results in a marked deterioration of the soil. The earth is unduly exposed to the sun's rays, the humus is bleached and burned out, the heavy growth of young shoots from each stump further exhausts the soil, and after a few generations, holes are found in such a coppice forest where a stump has failed to send up sprouts owing to diminished vitality. In addition, a sprout forest which has been repeatedly coppiced tends to go to pieces at an early age, so that it is always wise to provide a number of trees of seedling origin, during each rotation, to insure continued vigor and productivity.

In the forest, trees produce fertile seed on the average at the age of thirty-five to forty. The open grown trees of the same

* Natural regeneration of woodland from sprouts is best secured before the age of sixty is reached. The stump should be cut low and slanting, the latter provision preventing early decay in the parent stump from infecting the young sprouts.

species may produce seed from ten to fifteen years earlier. Seed production is largely a matter of food surplus, so that while a little seed may be produced nearly every year, "seed years," when large quantities of seed are produced, only come after a succession of growing seasons, during which favoring conditions of light, heat and moisture have built up in the tree a surplus of energy and available material necessary to the production of

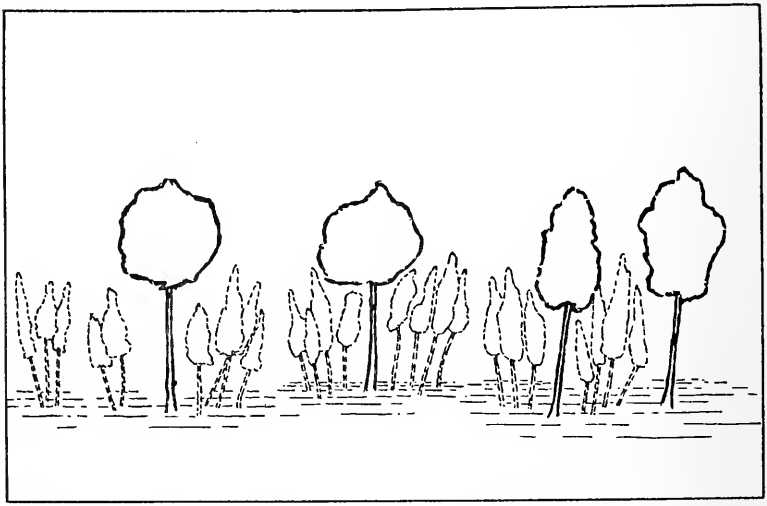

PLATE 3. COPPICE FOREST UNDER STANDARDS, showing where a few healthy trees of seedling origin have been left in the forest to provide some larger sized logs and continued reproduction by seed.

seed. Such a series of seasons permits the tree to accumulate more food than it needs for its annual growth, and this excess is consumed in the manufacture of the seed.

When the seed is ripe, it generally falls, although different species have different times to liberate their seed. The poplar, willow, elm and soft maple shed their seeds in the spring. Pines, spruces, chestnuts and oaks and the majority of the trees shed them in the autumn, while some, like the grey birch, seem partial to shedding their seed when the earth is covered with snow.

At whatever time the seed falls, it must ultimately find soil and moisture and light conditions satisfactory, else it will not germinate. The willow, for example, prefers moist sandbars

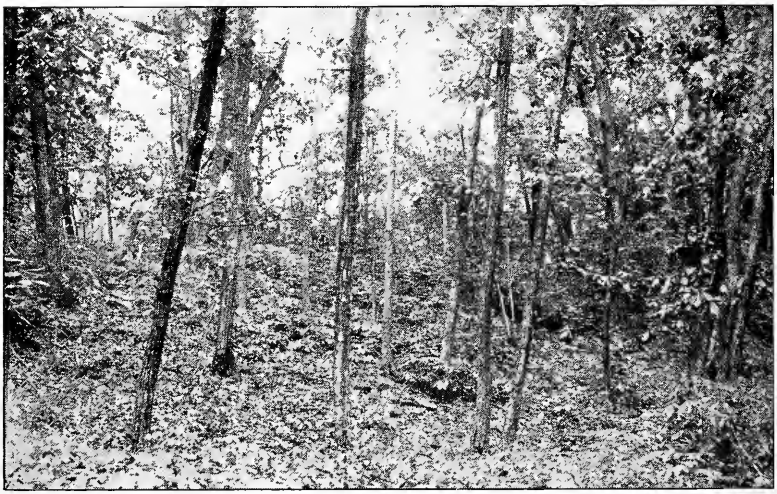

FIGURE 7. MIXED HARDWOOD FOREST IMMEDIATELY AFTER AN IMPROVEMENT CUTTING. Dead, diseased and undesirable specimens have been removed. Thus the total growing energy is concentrated upon a few selected stems.

where full light is available; the poplar and white birch seek out burns where the leached ashes generally permit the seed to get in close contact with mineral soil. Hemlock and yellow birch find congenial conditions wherever there is plenty of soil moisture, and are often found germinating upon a moist, rotten log. Consequently, if a good "catch" of a desired seeding is to be obtained, the soil must be receptive for that species.

In the natural course of events after a full seed year, the ground beneath the openings of the forest is found carpeted with a dense thicket of young seedlings, large numbers of which perish during the first few years. Those that survive are the strongest and deepest-rooted, or the ones whose seed germinated upon a favorable spot. Competition is extremely keen during the first few years, and each one is trying to surpass its neighbor both in crown and in root growth, in order to obtain more sunlight and a larger supply of food and moisture. If the clump of seedlings is mixed, the species capable of making the fastest height growth have a decided advantage, as they will reach above and shortly overshadow the slower-growing individuals. Nature is always lavish in producing individuals, and so it is only a small fraction of the original number which remain alive after fifteen or twenty years. This struggle for existence among the seedlings occurring as a group beneath a hole in the forest canopy, or as a patch of reproduction in a nearby field, continues until the age of thirty-five or forty is reached, when the soil is firmly held by the most vigorous individuals. They are tall and slim, for height growth was more necessary at first than girth, and each is nearly the same size as its neighbor. Altogether, the several hundred which now occupy an acre represent the picked survivors of the thousands which started life upon this area.

From now on the individuals slacken their height growth, and begin to increase more rapidly in diameter and volume, while the numbers remain about the same. The forest canopy commences to rise above the ground, due to the clearing of the stem by the process of natural pruning, and gradually the middle-aged trees pass into forest veterans with short crowns and tall cylindrical stems, having no branches for many feet above the ground. At this time, when the trees have passed the stage of

most rapid growth, is the period when forests are said to be mature and may be harvested in order to permit another group of timber to be grown upon that spot. (If mature forests are allowed to remain too long, the annual volume growth is balanced by the death and fall of an occasional stem, so that it is true economy to harvest a stand as soon as it matures.) In short, the yield of a virgin forest at maturity is only a fraction of what could be produced by scientific handling. Forestry, like agriculture, can increase both yields and projects.

Improvement Cuttings

From the description of the development of the forest under natural conditions, it can be readily seen that Nature, while producing superb timber in her virgin forests, is reckless of time. It has been computed that from 250 to 300 years were needed to produce the average timber tree now coming on the market in the form of sawn lumber, while certain species like

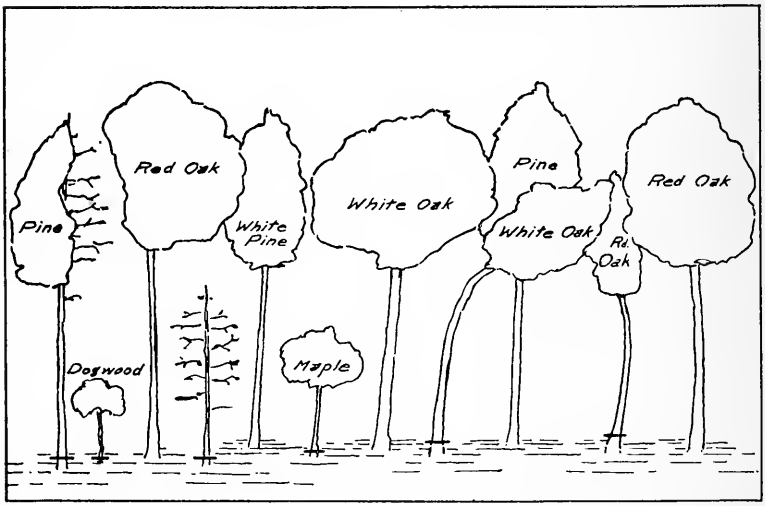

Plate 4. Improvement Cutting. The removal of the diseased pine, the worthless dogwood, the dead tree in the foreground, the suppressed maple, the crooked and suppressed white oak and red oak will not only increase the growing space available but also greatly improve the growing condition of the stand.

FIGURE 8. MIXED HARDWOOD FOREST FIVE TO SIX YEARS AFTER AN IMPROVEMENT CUTTING. Remaining trees have increased their growth in height and in diameter, since plant food, moisture and sunlight have been made available in larger quantities. Seedling and sprout reproduction has come up beneath their shade.

oak, longleaf pine and redwood may have taken a much longer period. When tending the forest, man plans greatly to reduce this time by shortening the struggle for existence. The undesirable and unfit specimens are removed by cutting, instead of permitting them to drag out their existence over a considerable period during which they will be continually robbing the leading trees of a portion of the food, moisture and growing energy. All growth should be concentrated upon the comparatively few selected trees of desirable form and species, which are to be the final harvest from the woodlot. This is the key to all cultural operations carried on and in an immature forest.*

The cuttings made in an immature stand are intended either to improve the mixture, increase the growth rate, or both. They may be grouped under two heads:

I. *Cleanings.*
II. *Thinnings.*

I. *Cleanings.* By a cleaning is meant the removal of undesirable species and individuals from a very young stand—say, from two to ten years old—for the purpose of improving the mixture. In a piece of young sprout woodland, a cutting, made usually with a brush hook or light hatchet, would tend to favor seedlings over sprouts—straight thrifty individuals over the bent and slow growing "weed trees," like hornbeam, blue beech, pepperidge, etc.—and to cut out such weed trees or inferior species as gray birch, hornbeam, blue beech, black oak, etc., and give more room to the faster growing desirable trees of high technical value like ash, basswood, tulip poplar, white pine, spruce, red oak, etc. On account of the small size of the material removed, there can be no revenue derived from such a cutting; in fact, if labor is hired it may cost from fifty cents to two dollars and fifty cents per acre to properly clean a young stand. As previously stated, however, it is not desirable to invest any large sum of money in woodlot culture. Cleanings, thinnings, and final cuttings can be successfully made without technical supervision by any one who knows the different trees and will keep the general ideas of growth in mind. It is

* Cuttings in a mature forest to remove the final crop and to prepare for natural generation will be described in another chapter.

simply a matter of removing the weed trees and permitting the desirable species and individuals to make the most profitable growth. (See diagram.)

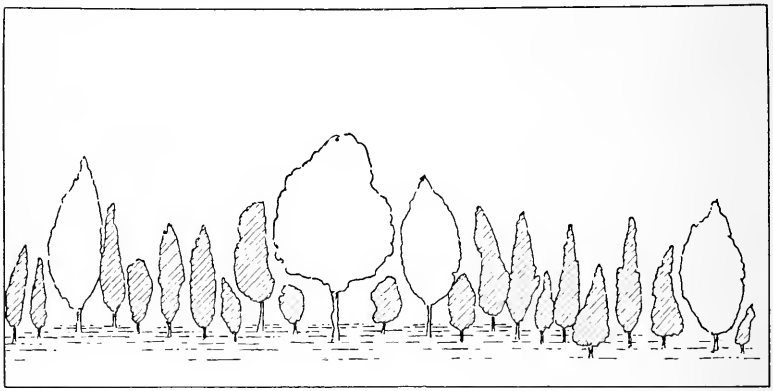

PLATE 5. CLEANINGS. The removal of the four individuals of undesirable species or character will give more room for the growth and development of the other components of the stand, whose desirability is characterized by more rapid growth and a higher technical value of products.

II. *Thinnings.* In the case of many woodlot owners, such an intensive operation as a "cleaning" seems impossible and a useless undertaking. However, many a forest owner has spent seven to ten dollars per acre in planting upon abandoned pasture with pine, when three dollars per acre, spent for the removal of gray birch from an old field, seeding into pine, would have produced equally good results. For those, however, owning a large amount of forest land and having little extra labor, it might be well to let the individuals in the forest community fight it out among themselves until the saplings become large enough to repay the cost of removal—say twenty-five to thirty years—when a thinning may be made.

At this time three classes will have formed, and already the trees which will form the final harvest can be picked. To assist these individual trees by cutting away crowding neighbors of valueless species, or by removing hopelessly suppressed trees which are diverting food, moisture and growing energy from the thrifty leaders, is but the part of good judgment.

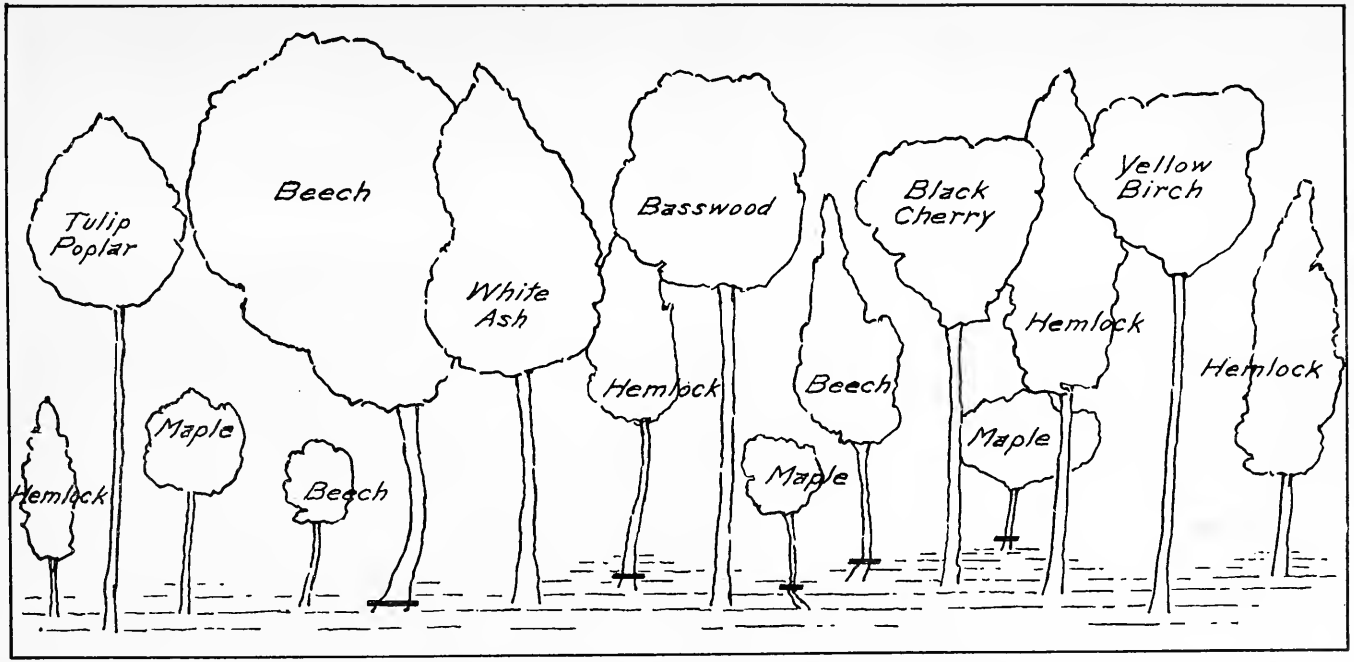

Plate 6. Thinnings. The purpose of a thinning is to seek the best development of the trees designed for the final harvest. The removal of the crooked-boled, large-headed beech will give the tulip poplar on one side and the white ash on the other more room and growing space. The removal of the hopelessly suppressed hemlock, beech and maple (in the right center) will divert to the desirable survivors an increase in food material, soil moisture and growing energy.

In a sprout hardwood forest, if an early cleaning which would cut out all but three to five of the best sprouts per clump were out of the question, it would be possible to let the dozen or more sprouts per stump grow untouched until the smaller were large enough to make fence posts or small cordwood. Then a thinning could be made in which all but two or three of the tallest and straightest stems growing from a single stump were cut away allowing them to utilize all the growing energy of the wide-spreading root system. This process could be repeated every five to eight years, and it is claimed that instead of taking forty-five to fifty-five years to grow chestnut railroad ties, such thinnings, by reducing competition and forcing growth into a fewer number of selected stems, has produced the same size material in ten years less time. The same idea, with approximately the same result, can be carried out in any sprout forest.

In a pine or spruce stand, thinnings are frequently needed, as nature often sows the seed much too thickly for rapid growth. While it is true that splendid knot-free timber is produced as a result of close sowing or planting (natural pruning being started at an early age owing to the speed with which the lower branches interlace) too close planting is a drawback. In dense pine or spruce thickets, a cleaning would be very advantageous in shortening the struggle for existence. If neither time nor money is available, the forest may be left until bucket stock or pulpwood size is attained, and then a thinning can be made.

With these two species, a cutting called the "French Method" can be used. This consists in going over the forest at say from twenty-five to thirty-five years and selecting from the 600 to 800 stems which are found upon an acre, 250 or 300 specimens which are the tallest and straightest and making the best growth. These 250 are picked to form the final crop. All trees interfering with these selected specimens are cut away to hasten their growth, but the trees which are not competing or hindering them are allowed to remain as it is *never wise to open too large holes in the canopy nor to expose too much of the forest floor at one time, as growth will be severely checked.* Not more than 20 to 25 per cent of the trees should be removed at any one time. In order to keep the forest producing timber at its maximum

FIGURE 9. GROUP CUTTING IN MIXED FOREST. A clump of mature decrepit hardwoods has been removed. White pine reproduction will be assured by the presence of seed trees of that species on the margin of the opening.

capacity, the forest floor should be kept *"dark," i. e.,* a minimum of light should be permitted to reach the soil beneath the trees, since light brings weeds and grass, which tend to rob the trees of plant food and moisture.

A similar operation may be performed every five to ten years until the final harvest. The material removed at the first thinning may just pay for the cost of removal, but each succeeding thinning should show an increased return, while the financial gain in shortening the rotation, in growing barn boards or first grade saw timber in fifty-five years, instead of seventy, will abundantly repay the cost.

Pruning

Whether or not it is desirable or profitable to remove green branches to make clear lumber is a mooted question. In certain parts of Massachusetts, mill owners cutting in second-growth pine affirm that artificial pruning undoubtedly produces loose knots in the lumber sawed from such trees, owing to the rapid drying out of the knot inside the tree.

The Forester at Baltimore attempted to obviate this drawback by cutting off with an axe the lower limbs of his young pines, leaving a stub six to eight inches long. Four or five years later, men were sent through this area again cracking off these stubs, now dead and dry, with the poll of the axe. The annual rings laid on thereafter were free from knots, and the more gradual drying out of the knot, as well as the speed and economy with which this form of pruning could be accomplished, makes it sound feasible and possibly profitable.

*Reforestation**

While the artificial starting of forests has been quite popular in New York with a certain type of land owners, farm owners, as a rule, do not plant up large areas with seedlings or transplants. Most of them already own more or less woodland, and quicker returns may be obtained by improving the mature woodlot, which has already a certain amount of forest capital standing upon it, rather than by starting a new forest which

* Stephen, John W., Making Best Use of Idle Lands in New York. Circular 19, New York State College of Forestry.

will not yield cash returns for some years. However, in common with other permanent land owners, reforestation offers to the farmer an admirable solution for the problem of idle land.

The points in favor of reforestation are as follows:

1. It puts the idle land to work. The census of 1910 proved that there were 7,000,000 acres within New York State inclosed within fences which the owners themselves declared to be idle. Assessing such land at $5.00 per acre, the total capital of the New York farmer invested in idle land amounts to $35,000,000, which, at 4 per cent, is capable of earning $1,400,000 per year. The permanent prosperity of any state or nation can only be secured by the full and proper utilization of *all resources,* and the planting of lands now unproductive would in a comparatively short time change them from liabilities to assets.

2. The appearance of the property is greatly improved, thereby adding to its market value in case of sale. Any one experienced in real estate realizes that an attractive woodlot or young plantation is infinitely preferable both in appearance and cash value to a rocky slope or a creek bottom subject to overflow. Appearance as well as real estate value and future cash value are all improved by planting up such sites.

3. Plantations will at the end of the rotation show a profit in excess of 5 per cent compound interest, even based on present timber prices.

Forestry is essentially economic and the financial results of planting non-agricultural land in older countries compare quite favorably with other long term investments. In fact every permanent owner of land will find the appearance, the present and future sale value of his property increased by planting forest seedlings.*

* Land should be cheap and the planting costs should be kept moderate from $7 to $10 per acre if the above return is to be obtained. For further information regarding planting, see Circular 19, New York State College of Forestry.

Another phase of forest planting that could well be adopted by the woodlot owner is underplanting. It has already been shown that where natural regeneration is incomplete, following the cutting out of a woodlot, desirable species may be introduced by planting young seedlings or transplants in groups in order that the proper mixture be obtained. The same idea can be carried out in younger stands, especially those of sprout origin. In this way new blood in the form of coniferous stock may be introduced in run down woodlots.

> While two-year-old seedlings will serve in an open field having sod of only moderate thickness, three- to four-year-old transplants are required where the sod is thick or the trees overhead may suppress the planted material.
>
> In addition the old trees on an area to be underplanted are likely to absorb a great deal of moisture through their wide spreading root systems. Thus for several reasons the hardier, stockier transplant is more desirable.
>
> As a rule it is hardly safe to attempt underplanting if more than 0.6 of the surface is already covered by trees. Pine transplants may be used in the larger openings while spruce, Norway or native red spruce can stand more shade. The former species require less moisture than the latter.

This phase of underplanting would consist of planting 300 to 500 evergreen transplants (depending upon the ground cover and amount of shade) in among the hardwoods, placing the plants in groups five to six feet apart each way, or five to six feet from the nearest sprout.* Thus a complete stand could be secured at a minimum cost, for the young hardwood sprouts will furnish sufficient side shade to stimulate height growth, and could be removed with a brush hook when they threaten to choke out the conifers.

Experiments have been made with this type of underplanting, and it has been found that each plant costs about three-quarters of a cent in the ground. Six hundred per acre would cost $4.50, and the subsequent cost of labor, brushing out around the ever-

* The farmer possessing the land, the time, the equipment, etc., should handle his woodland so as to make it yield. He is in an unusually good situation to grow desirable timber crops at a minimum of expense.

greens would still bring the cost considerably below that of a pure plantation, and a mixed forest of highly desirable species would be the result. In this, as in all other operations connected with getting a forest started and bringing it to maturity, if the crop idea is kept in mind, there should be no difficulty in understanding and carrying out the necessary steps.

Aesthetic Considerations

The foregoing recommendations of the trees to be favored when cuttings are made were based upon economic considerations—that forests are owned and managed primarily for revenue. Frequently, however, forest owners are found who own their woodland primarily for beauty, and to such, the above recommendations might not directly appeal—though all well-kept mature forests are beautiful. Estate owners often select trees for their form, for their foliage, flowers, etc., and to such, the classification of dogwood as a weed-tree would seem preposterous. *Between these two extremes there is a mean which owners may strike by handling certain portions of their estate as a producing forest, while the parts along the drives and walks, or those visible from the house, can be kept in their natural state.*

For adding to the appearance in winter, evergreen trees should be favored. Pines and spruces have already been recommended for their technical value and rapid growth, but as an ornamental tree, hemlock is probably superior to the other two conifers, on account of its graceful foliage. Economically, it is not strongly recommended on account of its slow growth, yet in proper locations, its presence in the mixed forest is to be desired.

In spring, no tree can surpass the dogwood in beauty, and in prominent situations its presence and reproduction may well be encouraged. In the fall, a variety of trees appear to their best advantage from an aesthetic viewpoint. Scarlet oak, red maple, pepperidge (*Nyssa sylvatica*) and beech all add to the color of the woods. Other species with graceful form like the elm can be encouraged for year-round charm, especially along roadways or to frame an attractive view. Such trees as the above may be spared and encouraged with but little financial loss in many cases, but in each instance there should be a clear differentiation

in the mind of the owner, which items of expense should be charged to economic forestry and which to landscape improvement.

Under ordinary circumstances, however, pruning is an intensive operation quite beyond the reach of the average woodlot owner. If pruning a nearby piece of woodland will add to its attractiveness, it may well be pruned. As a general proposition, it is better to charge the cost of such an operation against "landscape improvement" rather than against "forestry."

CHAPTER IV

HARVESTING THE WOODLOT

While it has been said that no tree ever dies a natural death, nevertheless there comes a time in the life of every piece of woodland when it should be harvested to avoid loss. Its height growth may have ceased, its volume growth may have greatly diminished, there may be an unsually large number of dying trees; or an unusual demand for lumber may make it desirable to reap the mature trees while the prices are high (since the forest crop, being imperishable, may be held back until the market conditions are right). In deciding to reap the forest crop, two points should be kept in mind:

1. Unless of pronounced agricultural value, the woodlot should be cut in such a manner as to keep it producing forest materials of the best kind. If the land is comparatively level and fertile, it may be cleared and planted to field crops as needed because sound economics demand that. If sufficient tillable land is already owned, it may be allowed to remain as a woodlot.

2. The amount and approximate value of the woodlot products should be known before the cutting is started.

Reproduction Cuttings

While foresters group cuttings made for the purpose of starting new growth under several heads, for the sake of simplicity, they will all be treated as belonging to one of two classes:

1. Clear cuttings, followed either by natural or artificial reproduction.
2. Harvest by repeated cuttings.

1. In the case of clear cuttings under intensive management, large areas are often cut clear with the exception of from five

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Note.—Concerning the methods of estimating the amount and value of forest products, see Chapter V.

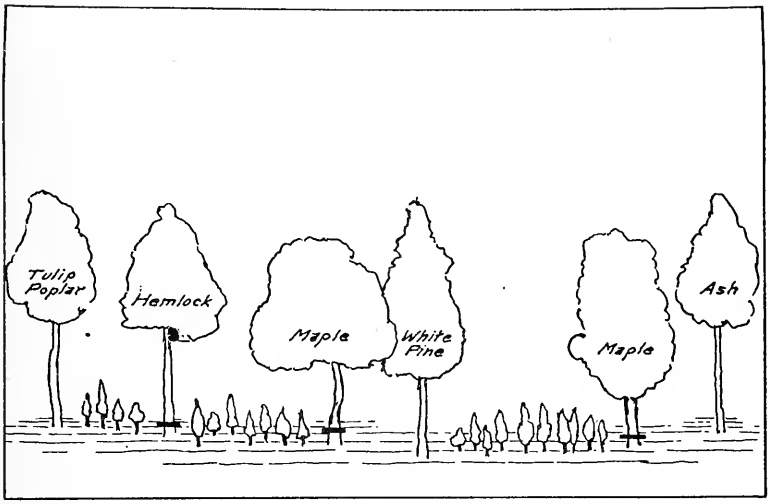

PLATE 7. REPRODUCTION CUTTING. Before the cutting, and showing the trees of the less desirable character which are to be removed.

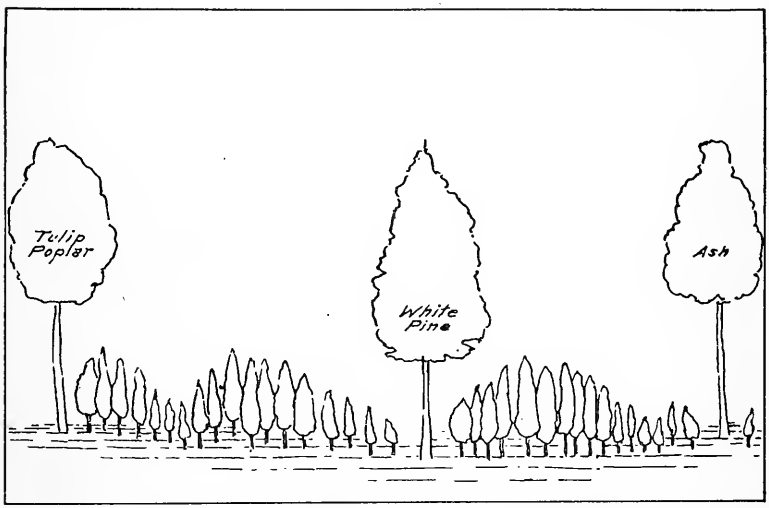

PLATE 8. REPRODUCTION CUTTINGS. After the cutting, showing the seed trees left of desirable species and the reproduction increased both in size and amount.

to twenty seed trees per acre which are allowed to remain in order to seed up the cut-over areas. Or, alternate strips may be cut clean, the uncut strips supplying the desired seed trees. In woodlot management, however, clear cutting on a large scale is hardly desirable, except in the case of maple swamps being handled for cordwood or vigorous young sprout hardwoods which can also regenerate from the stumps. The plan of removing the final crop during several winters by successively thinning the stand is much more beneficial as far as the soil is concerned, and fills in better with the regular farm work. However, in the case of an old, badly mutilated woodlot where all but a few score trees per acre have been cut, where seed production is slight, and the soil is too compact for easy regeneration, *clear cutting followed by planting with the desired species is the best solution.*

2. The method of "repeated cuttings" is the best method of harvesting the woodlot when all the needs of the average owner are considered, for:

It permits the woodlot work to be distributed over a number of seasons, rather than rushing it in one season.

It allows the sale of limited quantities of timber to the local market.

It supplies a sustained income.

It gives work to horses and men during the winter season when other farm work is slack.

Thus while silviculturally other methods of reproducing the forest crop might be more desirable, the plan of harvesting the largest trees or *mature groups* of trees (these groups will have to be made quite large in the case of light-demanding species) will prove the most practicable from an economic standpoint. *It is true in forestry as in agriculture, only those methods should be recommended which are practical and financially sound.*

Consider then the problem of starting with a *mature* woodlot of average condition (for cuttings in immature stands, see Chapter III), and it should be realized that much more can be done with a mature woodlot even though somewhat run down than is often appreciated.

FIGURE 10. CLEAR CUTTING IN SOFT MAPLE SWAMP. Owing to its excellent sprouting capacity, soft maple stands can clear cut to advantage. A large mean annual growth is thereby secured.

Marking the Trees for Removal

Having decided upon logging the woodlot during a given winter, the land should be looked over during the fall before the snow has fallen, and the points of attack selected. It may be necessary to start the cuttings at several points which in the course of a few seasons will merge.

The ripe timber which is no longer increasing rapidly in volume, or may even be deteriorating in quality, should be marked for removal. It is quite common to blaze these trees with a marking axe, and to be on the safe side, a stencilled marking hatchet may be used. If the trees are blazed twice, once about four feet from the ground and again six inches above the ground, it is easy to detect the removal of unmarked trees.

As previously stated, much of the neglect and present small value placed upon the woodlot results from the poor financial yield obtained from the sale of its products. *This is almost entirely due to the inefficient methods of marketing adopted in disposing of them.* Woodlot owners, and even experienced portable mill operators, often commence cutting without any idea of whether the market is glutted or empty; whether hemlock or oak is in greatest demand; whether inch stuff or dimension material is needed. In most cases, the lumber is sawed in the dimensions which are easiest for the sawyer, and as a consequence, there is often a large pile of material left on hand at the end of the season which could have been readily sold had it been sawed in *some other size.* In forestry, as in agriculture, the difference between profit and loss often lies in the way the products of the soil are *marketed.*

Study the market before marking the trees.

Many small forest owners, ignorant of lumber markets and prices, will claim that such a marketing problem is beyond them. However, it will take only a little time and a few letters, and the difference in cash returns will repay the effort many times over.*

* The Utilization Service of The New York State College of Forestry at Syracuse maintains a selling list by which it endeavors to bring together the producer and consumer of forest products. If this is not sufficient assistance, the College of Forestry stands ready to send out trained foresters to inspect woodlots within the State and to make recommendations concerning their management and marketing.

In some cases, undoubtedly the shortage in labor, teams, equipment, etc., may make it impossible for an owner to do his felling, skidding, etc., himself. It may be necessary for him to let out all or part of these operations. In such cases, there should be a written agreement concerning the methods to be used by the contracting party, rate per thousand board feet for piling, skidding, hauling, sawing, etc.; even then it is valuable for the owner to know the value of the final product, the cost of each operation and the margin of profit upon each step.

In an ideal case, the steps from the stump to the mill at least would be carried on by the owner or his employees, and thus a satisfactory check could be kept upon the work. Low stumps could be cut, as the woodsmen's saying, "One foot in the butt is worth four in the top," holds approximately true. The crowns above the portion of the trunk suitable for saw-logs should be utilized as far as possible. Posts, props, cord wood, etc., should be cut from the tops not only for the greater revenue that will be derived but also because closer utilization of the top wood means the removal of a large part of the inflammable material, rendering fires less likely, and far less severe if they do occur, and also will make natural regeneration more certain.

In felling the trees, care should be taken that the stump is low (not higher above the ground than a distance equal to the

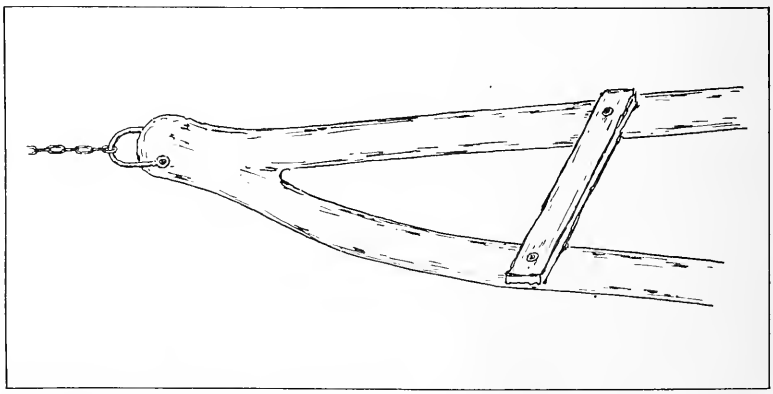

PLATE 9. LOGGING LIZARD. A home-made sledge for skidding logs on the farm woodlot. Its low carriage enables one man to handle heavy logs with ease.

diameter of the tree is a very good rule to follow); that the undercut is sufficiently deep to avoid a bad splintering of the butt log; and that the trees are dropped so as to cause a minimum of damage to the young growth.

Carelessness in "bucking up" the tree into log lengths often causes considerable loss, and the felling crew should be watched to be sure that the trunk is cut into proper log lengths which will yield a maximum of timber. It is customary to allow two to four inches extra in log lengths to provide for checking on the ends of lumber, but to cut from seven to nine inches over the proper length means unnecessary waste.

In addition, the log lengths should be measured off with regard to crooks in the trunks, as often much waste in slabbing is caused by a crook in the middle of a log. With proper supervision all these can be secured, and in case any of the cutting and skidding are done by contract, penalties for gross carelessness should be provided.

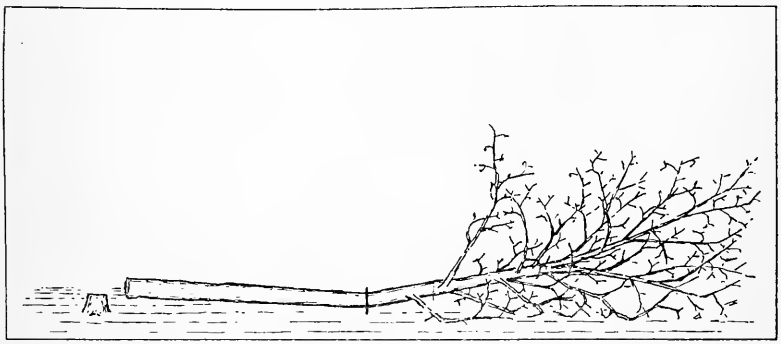

PLATE 10. LOG MAKING. Good log making is a requisite of good forest management. Avoidance of crook in cutting up a tree into logs saves a great deal of waste in slabs and sawing.

The sawing may be arranged for, either at a nearby stationary mill, or, if the season's cut is sufficiently large, a portable mill may be brought to the woodlot. Ordinarily a job of from 50,000 to 75,000 feet will warrant bringing in a mill. If a single woodlot will not supply this amount, several adjoining owners may arrange to cut their timber at the same time, and this will make it worth while for the mill owner to "set up."

Unless the stumpage owner has had unusual experience, it is better for him to hire an experienced sawyer, since sawing by an inexperienced man is a slow operation and results in reducing the grade of much good lumber.

If the owner desires to provide winter work for his teams and employees, he can agree to fell, buck, skid and haul logs to the sawmill at a fixed price per thousand board feet. This will insure careful felling and avoid injuring young trees, since the "brush" and saplings of to-day are the timber trees of to-morrow.

It is not only necessary to manufacture lumber with care, to see that the machinery is properly adjusted, that no "thick and thin boards" are sawed, etc., but the treatment after sawing is equally important if the full profit is to be derived from the woodlot products.

Sawing to Bill

In the first place, it is imperative to know just what amount of lumber to saw of each dimension. Some portable mill owners, as soon as they have estimated the contents of a piece of woodland, will attempt to sell the timber before they have even purchased it, and the most successful operators always dispose of the majority of their stumpage before they start to saw. This permits them to make out a list or bill of the amount of timber of each size and species for the guidance of the sawyer. Such foresight insures the sale of all the timber at a good price, since just the sizes in demand will be turned out. *Always saw to bill.*

Grading

Another point frequently overlooked by the average owner is the matter of grading. In addition to poor sawing, lumber manufactured at a small mill usually brings a lower price than the same material sawed at a large mill, because it is not graded. All sorts, conditions and sizes are usually lumped together, with the result that the price usually offered for ungraded mill run is just about what the poorest in the pile is worth. In one case, where lumber of a species commanded $24 per thousand board feet, mill run, the operator received as high as $40 per thousand for his better grades and raised the average price per thousand for that species over $30. *Grading pays.*

FIGURE 11. PORTABLE SAW MILL. While the average portable mill is not as efficient as a fixed mill with modern band saws, good results can be obtained by careful management.

Stacking and Seasoning

By the inexperienced, piling and seasoning are regarded as unimportant parts of the process of lumbering, yet as much money may be lost by careless piling as in any other part of the business, since poor piling means the reduction in strength and quality, and in some cases where rot sets in, there may be total loss.

Free circulation of air is necessary for proper seasoning, so the piles must be placed upon a site having good air drainage, and each board in the pile should be slightly separated from its neighbor to permit the gradual evaporation of water. Ordinarily, about one-half the weight of wood is water, and full seasoning reduces the shipping weight as well as adding to the strength and freedom from warping. *Cheap piling is poor economy.*

Cost of Manufacture

Manufacturing costs of the various steps in lumbering a woodlot in different parts of New York will, under normal labor conditions, average as follows (depending on local conditions*):

	Per M. bd. ft.
Felling and sawing into log length	$1 25— $1 75
Skidding (hauling to mill)	1 50— 2 50
Sawing	5 00— 6 00
Piling	75— 1 00
Hauling (depending on distance)	4 00— 6 00
Total	$12 50—$17 25

After the saw timber has been skidded, the top wood should be worked over. In some parts of the State, the tops and standing cull timber may be sold at a given price per acre to the owner of a small gasoline "buzz" mill. In such cases, the price is fixed, depending on the amount and quality of material left and upon the local demand for cordwood.

In most cases, however, the owner will either have the work done by day labor or pay a given price per piece for the manu-

* On account of unusual labor conditions it is difficult to obtain figures for the various steps in manufacture which will hold true for any length of time. The above costs were gathered in March, 1920.

facture of the various products. These prices will range as follows:

Ties:	Hewing—Firsts	$0 35—$0 55
	Seconds	25— 30
	Hauling	15
Switch ties:	Hewing	1½ cents per running foot
Cordwood:	Cutting and stacking	$2 to $3 per four-foot cord

Pulpwood

In regions where pulp mills are located, such species as poplar, spruce, balsam and hemlock can be most profitably marketed as pulp bolts. The cost of production in these regions range as follows:

Poplar:	
Cutting	$1 25—$2 25 per cord
Peeling and piling	1 75— 2 00 per cord
Hauling	3 50— 4 50 per cord
Spruce and balsam:	
Cutting	$1 25—$2 25 per cord
Peeling and piling	1 75— 2 25 per cord
Hauling	3 50— 4 50 per cord
Hemlock:	
Cutting	1 50— 2 50 per cord
Peeling and piling	1 75— 2 50 per cord
Hauling	3 50— 4 50 per cord
Hemlock bark	18 00 per cord

On account of the tremendous shortage of pulp stock that prevails at present, such products as the above can be marketed at a splendid profit. In fact, many of the largest spruce operators of New York and New England have for the past few years been turning all of their timber, large and small, into pulp, finding that product much more profitable than saw timber.

Close utilization of small timber is proving financially desirable to the largest timber owners, and in the case of the small owner, the sale of such material as posts, cordwood, roller stock, etc., may pay the entire logging costs, leaving the saw timber as "velvet." Above all, such close utilization leaves the woodlot in better shape from the standpoint of appearance, ease of regeneration and diminished fire risk.

Brush Disposal

When the last saw logs have been skidded, there is usually a large accumulation of branches, hollow butts, smashed tops, etc.,

cumbering the ground. To clear up this débris is an important problem, since slash of this kind is not only a bad fire menace, but often prevents both seed and sprout regeneration. Good management demands that the ground be cleared as soon as possible. The longer and straighter sticks can be used for fence posts and props, while the shorter pieces may be used as orchard props, stakes, etc. Hollow butts, large limbs, crooked trunks, etc., may be sawed into cord and stove wood. Ordinarily such an operation will leave comparatively little material behind that will long be inflammable, since the smaller hardwood brush becomes soggy after a few winters.

In the case of clear cuttings in hardwoods, or where heavy stands of pine, spruce or hemlock have been cut the heavy brush remaining constitutes a more complex problem. Hardwood tops are often piled in windrows and burned in the spring when the ground is too moist to permit the spread of fire.

The question of whether to burn or merely pile the brush is a matter for each owner to decide, depending upon the conditions which obtain in his own woodlot. They all, however, increase the logging cost, the prices for brush disposal ranging from twenty cents to fifty cents per thousand board feet of lumber cut. This expenditure must be considered as a form of insurance, as the remaining timber is rendered more safe and the forest as a whole is, in the long run, much more productive.

Regeneration

The idea underlying forest management is to raise repeated crops of the most valuable timber upon soils unsuited to agriculture. Thus the aim of harvesting mature timber is not only to obtain revenue from selling the forest products, but also to make room for the young seedling which will produce the next crop of timber. If the starting of new growth is not secured by the cuttings, the operation, from a forestry point of view, has not been a complete success, no matter how much revenue has been obtained. If the land is level and fertile it may be wise to clear cut, pull the stumps and add the area to the tilled or pastured lands, but on the typical New York farm, the woodlot now largely occupies land unsuited to tillage or pasture. Intensive forestry practice demands that cuttings be timed according

to the seed production of the species to be favored. However, in ordinary woodlot management it is necessary to plan the logging with regard to local market conditions and the labor situation upon a given farm. The reproduction resulting may not be so successful, but a little assistance later on will generally give the kind of regeneration desired. (See Cleanings, p. 51.)

Species to be Favored

To specify in a general publication the exact trees each private owner should favor upon a given site is an extremely difficult proposition. It depends not only upon the section of the State in which the woodland is located, but upon the question of site, such as soil and moisture conditions, elevation, topography, etc., and upon local demand as well. Specific recommendations can be made only after a careful examination made upon the ground, but general suggestions can be made which should prove helpful.

Species possessing the best qualifications should be favored during the harvest either by leaving a sufficient number of seed trees and cutting out nearby trees of lesser value quite heavily or by underplanting these species after the mature timber is removed. The more desirable qualifications would be as follows:

1. Species common to the site and region should be encouraged, and native trees should be given preference over foreign trees in planting.

While it is true that in certain parts of the State either pine or spruce, for instance, will thrive, it is safe to say that, as a rule, the species found in larger numbers are generally better suited to the region. (This rule does not always hold, however, since in certain cases of two species, the more valuable may have been most heavily cut, and so may have largely disappeared from the region. Yet it would grow and flourish if planted. An excellent instance of this state of affairs is furnished by the absence of pine in the Hudson highlands.)

2. Trees should be both fast growing and technically valuable.

Certain species like the white oak, for instance, yield timber of great value and beauty, yet its slow growth (estimated at about one inch in diameter for each ten years) makes it undesirable as the principal tree in a woodlot.

3. Species favored should be comparatively free from insect and fungous attack.

While it is true that practically no species is entirely immune, yet certain ones succumb much more readily than others. The chestnut, while fast growing and technically valuable, should not be favored throughout its range on account of the chestnut blight—*Endothea parasitica*—which is proving so fatal to this species. In the same way, mixed plantations of red and white pine are to be preferred to pure white pine plantations until the outcome of the white pine blister rust can be predicted.

4. The trees to be favored should furnish products which are and will be in demand in that particular locality.

Just as raising fruit in a wheat country often means difficulty in disposing of the products, so may the sale of pulpwood in a box shook district often present difficulties. It is not possible to foresee the market demands at the end of the rotation, but the past demands and present industries may be taken as a guide.

From the above rules each owner can form a general idea of which species to reproduce and which species to eliminate from his woodlot by means of skillful cuttings. Where clear cuttings are practiced, five to ten seed trees per acre of the proper kind may be left so that their seed may fill the cut-over area with a thicket of young seedlings. Where group cuttings are made the situation is more difficult. All groups of reproduction of the right kind found on the ground at the time the cuttings are made should be freed, *i. e.*, have a circle of surrounding trees cut away to permit more light to reach them; occasional seed trees should be left, especially near large holes made by the removal of some large individuals, and lastly, inferior species, especially those of great reproductive vigor, should be

heavily cut in order to handicap them as much as possible. (Sometimes such trees may be only good for cordwood which furnishes a very small margin of profit, but will be found worth while to remove on account of the more valuable mixture that will be obtained.) As a rule, such measures will produce a splendid mixed forest which may need only an occasional light cleaning to produce the proper proportion of valuable species.*

In certain cases it may be that the species to be favored are the only ones that are readily salable in the form of saw timber. Then the only solution will be to cut and sell the saw timber, and at the same time turn as many of the inferior and competing trees into ties, poles, props and cordwood as the market will absorb, taking care to open up occasional fair-sized holes in the canopy. With the proceeds derived from the cordwood, 400 to 500 seedlings per acre of the best species can be planted in groups beneath the holes in the canopy which would introduce the desired proportion in the woodlot.

Specific Recommendations

Zone B. Throughout the Hudson Valley and Lake regions, (map, p. 18) chestnut, until fifteen years ago, would have been the best species to favor. On account of the rapid spread and disastrous effect of the chestnut blight, however, any efforts to favor this species are vain and other species should be favored during the cuttings. Red oak as a *dominant* tree is the best hardwood substitute for chestnut, while other valuable trees like tulip poplar and basswood, and particularly white ash, though rarely found in considerable numbers, should be encouraged in this region as much as possible in mixture. In practically all parts of this region, owing to repeated clear cuttings and frequent fires, the vitality of these sprouts has been greatly reduced. The introduction of softwoods which can thrive with less food and moisture will in time greatly improve the forest.

As introduced species in this region red and white pine, preferably in mixture rather than pure white pine, on account of

* Foreign forestry practice has conclusively proven the value of mixed forests. They are freer from disease than pure forests, less subject to windthrow and produce a larger yield than pure forests. In most cases a woodlot of several good species in mixture is more desirable than a pure forest.

the blister rust, should be encouraged. In forty years, yields estimated to amount to more than 25,000 board feet to the acre can be expected. Except in sheltered locations with plenty of surface moisture in the surface layers of the soil, spruce should not be planted in this region. Hemlock on moist sites would do very well in this region and would probably show a much faster growth than many of the hardwoods. Ordinarily it is difficult to underplant hardwood stands successfully if more than 40 per cent of the ground is covered by the tree crowns. Owing to shade and severe competition for food and moisture, the seedlings are likely to die.

The comparative value of hardwood forest versus the coniferous forest shows a superiority of the latter. The natural reproduction of hardwoods is attained easier and at considerably less expense, but only on the very best sites and situations will the financial returns be as good as that from a coniferous forest.

Zone C. In the foothills of the Adirondacks and Catskills, and in the portion of the State extending from the heads of the Finger Lakes to the Pennsylvania line (Zone C upon the map), beech, birch and hard maple are the dominant trees at present, with pine and hemlock occurring in the mixture. The two latter species have been more heavily cut in the past on account of their greater value. None of the above hardwoods are particularly fast growing, nor are their products in as great demand as the softwoods. White ash, basswood, red oak (wherever it is found), yellow birch and sugar maple are the trees to favor. If underplanting, either in mature forests or after cuttings, can be done, white pine, Norway spruce, and possibly European larch, in the larger openings could be used.

Throughout the spruce regions of the Adirondacks and Catskills (Zone D), spruce is the tree to be favored (diagram), and all hardwood stands containing an understory of spruce should have the big spreading maples, beeches, etc., removed as soon as possible in order to permit the increased growth of the more valuable evergreens. In the larger part of this region, spruce is now the most important tree, and on account of the high development which the paper or pulp industry has reached, it

will probably continue to be the economic tree for some generations.* White and red pine can also be favored, particularly on drier situations.

In some portions of this region, poplar stands are found of greater or less area which have seeded in following a fire. These are temporary types, and in time, will be crowded out by other longer lived and more tolerant trees. Nevertheless, poplar can be made a very profitable tree crop and one that can be successfully managed by a small landowner. Owing to the habit of sprouting from the roots, a light cutting in a stand of poplar results in an almost instantaenous crop of "suckers" which in a short time produce trees large enough to make excelsior or pulp bolts, etc. A few years ago, the writer visited a woodlot near Stony Creek, New York, from which the owner was deriving a periodic income equal to approximately five dollars per acre per year. Every five years it was his custom to cut over this lot, removing the largest trees, the amount of growth which had been added in the meantime ranging from four to five cords. Such an intensive operation and the high cash yield was made possible by the proximity of his woodlot to a local excelsior plant which created an unusually good demand.

Another smaller type within the limits of the spruce area might be mentioned, viz., the pure white pine stands found in Warren county along Lake George and in certain parts of the St. Lawrence valley. On account of the great suitability of the soil for this valuable species, and because of the presence of sufficient seed trees in most cases, natural regeneration is easy. Protection against fire and grazing is all that is required to grow pine forests in such favored districts as the country surrounding Chestertown, for example. Throughout this pine belt, terrific loss would be sustained were the blister rust to get beyond control, but at present white pine is the tree to favor.

* On account of the market situation on paper and pulp products which has obtained since 1915 spruce is now extremely high. A recent quotation for peeled spruce bolts being $18 per cord delivered at the mill, Glens Falls, N. Y. While undoubtedly this price will subside somewhat when war conditions and prices no longer prevail, yet the startling advance made by pulp wood in the past few years ($10 per cord nine years ago) gives some idea of the prices that may be obtained for forest products in the near future.

CHAPTER V

MARKETING WOODLOT PRODUCTS

To the discerning landowner, it is evident that proper marketing methods will solve most of the financial problems pertaining to soil management. Successful crop production is largely a matter of putting the right crop on the right soil and securing sufficient intelligent labor to bring it to maturity. The majority of the money (aside from a disastrous season) is made or lost in selling the crop.

A similar situation obtains regarding the woodlot. Explicit information may be obtained regarding the best species to favor, how to cut and how to protect the woodlot, but if, through poor marketing methods, the balance sheet at the end of the operation shows no profit, forestry will be practiced by few landowners in New York. If a good return can be secured from timber growing, plenty of men will be found ready to care for their woodland, for profit is the best incentive. It has long been the opinion of the writers that too much stress in forestry has been laid upon the productive end.

Timber Estimating

The first step in marketing the lumber standing upon a woodlot is to find out how much there is to sell (both area and volume should be ascertained as accurately as possible). Trite as such advice may sound, it is true that countless woodlot owners have sold all of the timber on their woodland without having the faintest idea regarding the amount or value. If a farmer adopted the same plan with his other crops, *e. g.,* of selling a bin full of potatoes or apples without inquiring the market price or even without measuring the number of bushels, he would be considered worse than foolish, yet instances of lump sales of standing timber are too numerous to record.

Area

While it is upon the unit of thousands of board feet or cords or markets that the price is fixed, yet a knowledge of the approx-

imate area which the woodlot occupies is decidedly helpful, since an estimate showing the average number of board feet per acre is comparatively easy to obtain. (See Sample Plots, p. 78.) Considering the fact that farmers deal with land continually, it is surprising how little some of them know regarding the area in their timbered lands.*

An irregular piece of land can have its contents approximately ascertained by means of rectangles and diagrams, methods which are well within the limitations of any owner. (See diagram.)

An acre contains 43,560 square feet, and equals 160 square rods or 10 square chains. A square 208 feet on a side contains approximately an acre, as does a circle having a radius of 118 feet.

In but few cases is an actual survey with compass or transit and chain necessary. Practically every rural section has its own surveyor who can do this work if required.

Timber Cruising

The actual measurement of standing timber is called "cruising," and while long experience is needed to obtain accurate results, even a novice may obtain a fair idea of the amount, species by species, by following directions.

Practically all methods of measuring standard trees are based on the plan of measuring a certain part of the woodland, say 5 to 25 per cent, and assuming that the remainder will average approximately the same. *It should be kept in mind that the smaller the woodlot the larger must be the percentage measured in order to strike a good average.* In but a few cases, *e. g.,* where the woodlot is very small and the individual trees extremely large and valuable is it necessary to measure all the trees.

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* The writer on one occasion was estimating the timber on a woodlot and asked the owner how many acres it contained. He commenced with the total area of the farm taken from a deed 75 years old and by deducting field after field announced that there should be 15 acres in the woodlot. Careful chaining proved that it contained 29.9 acres. In view of the superior quality of the timber in the woodlot such an error would have meant a loss of hundreds of dollars on a per acre valuation.

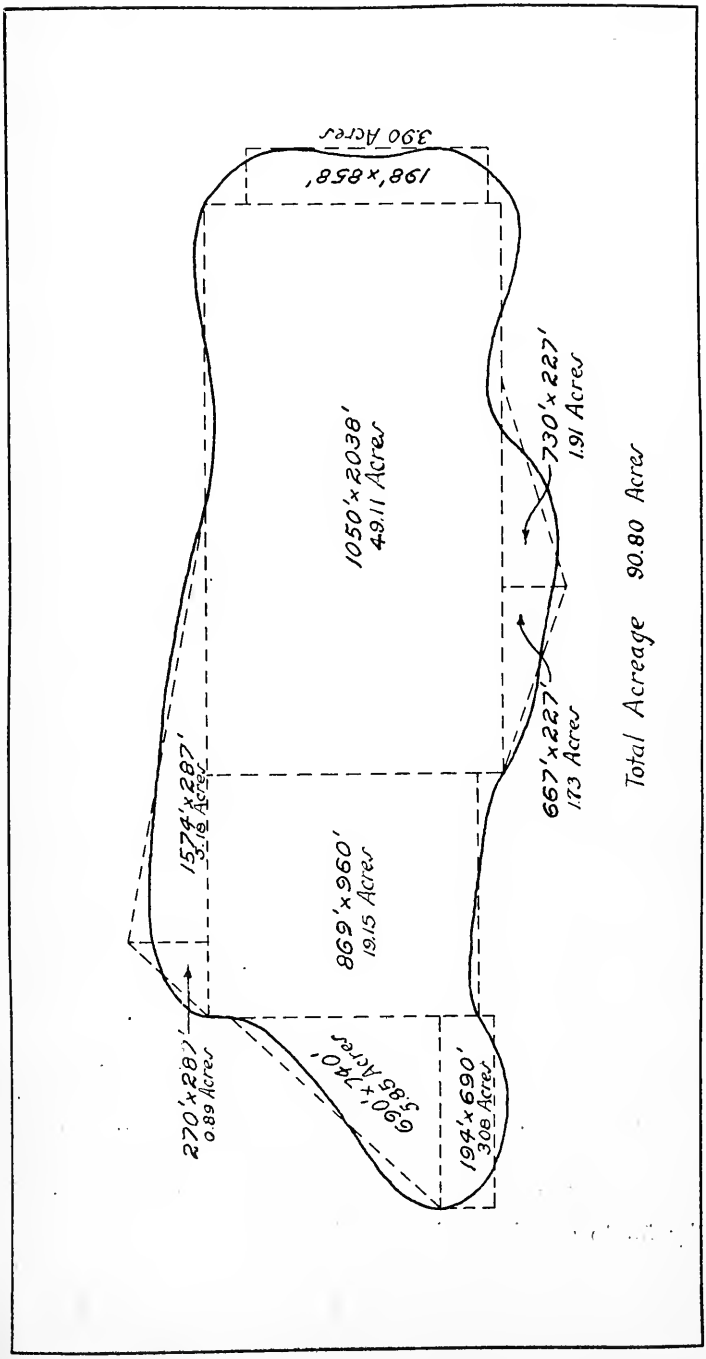

PLATE 11. Showing the method of computing the total area of a piece of woodland to be estimated.

Two methods of timber estimating are used by foresters. They may be called:

I. *The sample plot method.*
II. *The strip survey.*

I. *In the sample plot method the area of the woodlot must be known quite accurately*

The steps would be as follows:

1. Lay off a number of sample plots in average timber, the number depending on the size of the woodlot, either square (208 feet on a side) or round (radius 118 feet).

2. Measure the diameter of all the trees upon the plot, breast high, *i. e.,* 4½ feet from the ground. In regular forestry work, this is done by means of an instrument called a tree caliper, but for a single woodlot, this dimension may be obtained by finding the girth of the tree 4½ feet above the ground and dividing by 3 1/7.

An idea of the average height may be obtained by ocular estimate, or a ten-foot pole may be leaned against the tree, and the number of poles' length the tree will contain will give a rough idea of the height. (For evergreens the total height should be estimated, while for hardwoods only the part which will make saw logs is usually computed.)

3. The measurements are entered into a record or tally where similar measurements may be grouped together for further computation.

4. From a volume table, one for each species of tree, showing the contents in board feet or cubic feet of average trees of a given dimension and height, the contents of each tree standing upon the sample plot may be obtained. (See Appendix, Volume Tables and Their Use.) Their sum will give the stand per acre, and the average of all the sample plots, multiplied by the number of acres in the entire woodlot, would give the contents of all the standing timber. (In a fifty-acre woodlot it would be wise to take ten to twenty sample plots and their average would be multiplied by 50 to get the entire stand.)

In case only a rough estimate is needed, the contents of a sample acre may be obtained as follows:

1. Lay off a circle with a radius of 118 feet—1 acre.
2. Count all the trees within this circle.
3. Select a tree having average diameter either by guess, or measure all the trees and compute average diameter. Sample tree should be normal in form.
4. Estimate number of 16-foot logs the tree will yield, expressing odd lengths in fractions of 16-foot logs, *e. g.*, a tree yielding 36 feet of used length would be considered a 2¼ log tree.
5. Estimate top and bottom diameters *inside the bark* of this used portion, add and divide by two to find mean diameter.
6. Compute contents of sample tree by this rule of thumb:
   (Mean diameter^2—60) $\times$ 8/10 = contents in board feet of average 16-foot log.
   This figure multiplied by 2¼ (if stick 36 feet could be cut) will give contents of average tree.
   To illustrate, a tree 60 feet tall contains a 36-foot stick of saw timber which is 24 inches at stump and 16 inches at top *inside the bark*. Mean diameter equals 20 inches.
   Then (400 —60) $\times$ 8/10 = 282 board feet contents of average 16-foot log.
   282 $\times$ 2¼ gives 634 board feet as the contents of the tree.
7. Multiply contents of average tree by number of trees standing on the acre plot to find stand per acre.

Where the woodlot is small, up to five acres, it is desirable to estimate every tree separately. It is to be remembered that a timber estimate is comparable to the process of stock taking or inventory in any business, and that thought and care in proportion to the value to be expected is justified from a business standpoint.

A notebook or sheet of paper is prepared somewhat similar to the following diagram or schedule. (See page 80.)

The estimator sizes up the first tree and guesses how many logs can be sawed out of its main stem. Suppose this tree to be a sugar maple with about thirty-three feet of clear length and above that heavy branching. Allowing for the stump, there is about thirty feet of merchantable length or one sixteen-foot log and one fourteen-foot log. By looking at the tree carefully, the estimator decides that the diameter inside of the bark at the top of the first or butt log is sixteen inches, and at the top of the second log is thirteen inches. These figures are entered into the proper columns, as shown in the diagram, and the estimator proceeds to the next tree, where the same process is repeated.

Species	Butt Log			Second Log			Third Log			Total scale
	Length	Diameter	Scale	Length	Diameter	Scale	Length	Diameter	Scale	
	Feet	Inches	Board ft.	Feet	Inches	Board ft.	Feet	Inches	Board ft.	Board ft.
Maple, hard	16	16	..	14	13	..	..	..	..	..
Yellow birch	12	10	..	12	8	..	..	..	..	..
Sugar maple	14	15	..	12	12	..	..	..	..	..
Beech	16	13	..	16	16	..	14	13	..	..
Hemlock	16	20	..	16	16	..	16	12	..	..

After the estimator has gone all through the woodlot, he can sit down with a standard log rule, Doyle or Scribner, and look up the corresponding board foot values for the logs of his tallied dimensions. The getting of the total board foot contents of each tree and then of his woodlot is but a matter of simple addition. In figuring up totals it is highly desirable to collect all of the same species together, hard maple, birch, hemlock, etc., for purposes of finding out just how much of each is available. Advertisement for sale of woodlot products on the stump is always more acceptable when a probable purchaser can read the different amounts of each kind of timber that are available.

After each tree is estimated, it should be marked in some way so that there is no danger of it being measured again. A piece of chalk or string may be used or a small blaze made with a hatchet.

By the methods already described, the total stand of timber is obtained, but it is rare that the whole stand will be felled. To obtain a correct estimate of the amount of timber to be cut and sold, each mature or undesirable tree to be removed should be blazed, and when the estimate is made, two tallies as "cut" and "leave" can be kept. On one the trees to be felled and sold are recorded; on the other the seed and future crop tree, are set down. Computing these figures by a volume table will give the amount of stumpage *for sale* and the amount left *standing* after logging. Or, if the woodlot is large and valuable enough to furnish sufficient stumpage for a mill "set up" without a careful estimate, it may be possible to blaze each tree to be cut and later scale the logs from these trees at the mill rollway. However, a knowledge of how much standing timber a woodlot contains is always worth knowing, even in fixing the value of a farm.

In such a tally as this a separate sheet should be made for each species in order to avoid confusion, especially in the record regarding the species which it is desirable to favor. The simplest method of recording measures is by the "dot and dash" system. Each dot and each dash represents a separate tally of a tree.

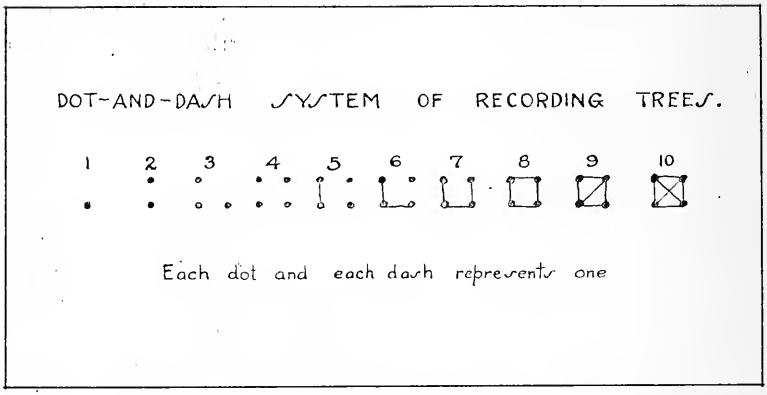

PLATE 12. Dot and dash system of tallying.

The tally sheet should be drawn up according to the form of Plate 13, and, as already said, it is better that a separate sheet be kept for each species.

Following such a tally as this it is a very simple matter to compute within each species the value of the "cut" and "leave" trees for each diameter class.

II. *Strip survey method*

The strip survey method of estimating a woodlot is the method most commonly used by foresters. It consists in measuring the diameter of all trees on a strip ordinarily four rods (sixty-six feet) wide. This strip is usually run from one side of the woodlot to the other, up and down hill, rather than along the slopes, in order to get a sample of both good and bad timber. When the opposite boundary is reached an offset of five or ten chains is taken and another strip run back parallel to the first.

Such a method has certain advantages. While an inexperienced man may locate his sample plots in timber that is much better or worse than the true average, strips run across the woodlot at fixed distances apart will generally compensate, and a better average may thus be obtained. Another advantage is, that by keeping track of the distance and direction (a compass being used in regular forest management) the need of a boundary survey is obviated as a good map may be drawn.

TIMBER TALLY SHEET

LOCALITY Woodlot Jas. Wilson. Canastota, N. Y. — BEECH — DATE June 6, 1920.

12.3 ACRES. — TALLEYMAN

DIAM. BREAST HIGH INCHES	1 LOG TREES						2 LOG TREES						3 LOG TREES					
	CUT			LEAVE			CUT			LEAVE			CUT			LEAVE		
	TALLEY	No.	VOL.	TALLEY	No.	VOL.	TALLEY	No.	VOL.	TALLEY	No.	VOL.	TALLEY	No.	VOL.	TALLEY	No.	VOL.
6	.	1	10	:.	3	36	:.	3	45	⁙	7	115						
7	:	2	24	⁘	5	65	⊠	10	200	::	4	80						
8				::	4	64	⁘	6	150	.	1	25						
9	.	1	20	:	2	36	⁘	6	180	:	2	60	.	1	77			
10				.	1	22	.	1	47				:	2	174	::	4	348
11	.	1	35				:.	3	156				::	4	400			
12				.	1	29	::	4	208	:	2	182	⁘	6	720	:.	3	360
13	:	2	70	.	1	35	:	2	132	:	2	220	:	2	280	:	2	280
14				:	2	84	:.	3	222	::	4	520	⁘	5	700			
15							::	4	480				⊠.	11	1870			
16										⁙	4	600	::	4	800	:	2	460
17							.	1	180				:.	3	690	:.	3	810
18													::	4	710	:	2	620
19													:.	3	910	::	4	1400
20													::	5	1950			

PLATE 13. Sample tally sheet showing the tally, the number and the volumes of the trees to be cut and those to be left.

(In small woodlots it might be well to find the area in acres first, and then obtain the average stand per acre by measuring all the trees on a strip which will total 20 to 50 per cent of the area. The strip being one chain wide, ten chains advance means one acre actually measured.)

The tally may be kept in the "cut" and "leave" form already illustrated. This form has the great advantage of showing the amounts of timber that will be left on the ground to form the nucleus of another crop of timber some five, ten or fifteen years later.

The form in which the tally sheet is ruled should be harmonized with the form of the volume table to be used. If the volume table shows a tabular statement of tree volumes by diameters and total heights, for example, the tally sheet should be prepared so that the trees will be tallied in the same units. If by diameters and log lengths, the tally sheet should follow that form. Accompanying is illustrated a sample of the tally sheet which follows the first-mentioned form.

The contents of the individual trees are computed by using the figures obtained from a volume table for that species and the contents of the average sample acre found by adding the contents of all trees, and dividing by the number of acres measured—then the contents of the whole woodlot are obtained by multiplying the number of board feet of each species upon the sample acre by the number of acres in the piece.

To illustrate: To cruise the woodlot outlined in Plate 11 the steps would be as follows:

1. Find the acreage of piece by chaining boundaries and computing contents.

2. Starting at some point a little distance in from one of the corners, start a line across the woodlot (using a compass if one is available; if not, keeping the line straight by sighting on a row of trees ahead), taking care that the lines run up or down the hill and not along the slope. (Stands are heaviest on benches and in the valley, while the size of the timber decreases as the top of a high slope is

SAMPLE TALLY SHEET for TALLYING TREES BY D.B.H. AND TOTAL HEIGHTS

NO. OF ACRES 8.25 Acres of Strip

DATE May 1919

LOCATION J. Thompson Woodlot

DIAMETER BREAST HIGH	YELLOW BIRCH					HARD MAPLE					BEECH					SPRUCE					HEMLOCK					WHITE PINE					BLACK CHERRY				
	TOTAL HEIGHT					TOTAL HEIGHT					TOTAL HEIGHT					TOTAL HEIGHT					TOTAL HEIGHT					TOTAL HEIGHT					TOTAL HEIGHT				
INCHES	50	60	70	80	90	50	60	70	80	90	50	60	70	80	90	50	60	70	80	90	50	60	70	80	90	50	60	70	80	90	50	60	70	80	90
6																																			
7																																			
8																																			
9																																			
10																																			
11																																			
12																																			
13																																			

PLATE 14. Sample tally sheet for estimate of large sized woodlot by strip survey method.

approached. Only by measuring both the good and poor portions can a fair average be obtained.)

3. Make out a tally sheet (following form in Plate 14). D. B. H. means diameter breast high, 4½ feet from the ground.)

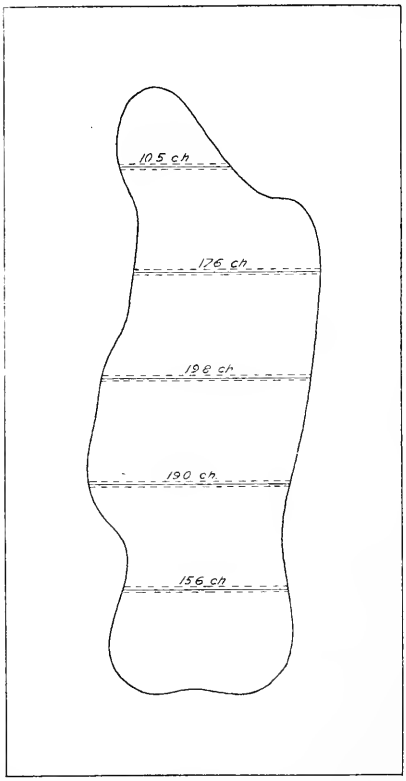

PLATE 15. Details of methods of running strips on ninety-acre woodlot in Plate 11.

4. The diameters of all trees over six inches in diameter standing upon a strip sixty-six feet wide are obtained. The total and *used heights* (amount that will make saw logs or pulpwood) of six to eight trees of each species is obtained.

5. The contents of the trees of each species are obtained by using the volume tables in appendix.

6. Divide the number of board feet of each species by 8.25 (82.5 chains were run, and since ten chains of linear distance mean one acre actually measured, 8.25 acres were actually estimated). This result will be the number of board feet of each species which an average acre would contain.

7. Multiply these results by 90.8, the total acreage, to obtain the total stand.

In the woodlot in question it was found that the following amounts standing on the acre measured:

Pine	Hemlock	Maple	Beech	Basswood	Miscellaneous—Elm, cherry
1,208 bd. ft.	2,542 bd. ft.	6,958 bd. ft.	3,274 bd. ft.	1,142 bd. ft.	1,477 bd. ft.

Dividing each of these amounts by 8.25 would give the following results:

Amount in Board Feet Upon an Average Acre

Pine	Hemlock	Maple	Beech	Basswood	Miscellaneous
143.4	300.1	826.3	388.8	135.6	175.4

Multiplying each result by 90.8, the number of acres in the woodlot, the total would be as follows:

Contents in Board Feet of John Thompson Woodlot

Pine	Hemlock	Maple	Beech	Basswood	Miscellaneous
13,020	27,249	75,028	35,303	12,313	15,926

Total, 178,839 board feet.

With figures like the above available the owner of the stumpage is in an excellent position to bargain with any possible purchaser.

Timber Sales

When the amount of standing timber has been ascertained, an excellent beginning has been made, but the deal has by no means been put through. The value of the stumpage must be ascertained and then a purchaser found, either for the standing timber or for the manufactured material. Moreover, he must be induced to pay a fair price, one that will show a reasonable profit to the grower, for, contrary to the accepted belief, it does cost something to grow timber when the interest on the land, taxes, etc., are all figured in.

Standing Timber

A very common way in the past has been to sell the land and timber together, or the timber upon the stump, either to a mill owner who manufactured the lumber himself, or the land and stumpage were sold to a middleman—timber buyer—who in turn disposed of the lot to a mill operator at a considerable advance in price. In either case the land and timber or simply the stumpage was bought for as little as possible, the ignorance of the owner concerning the amount and value of his trees and the value of the manufactured product causing him very often to accept a ridiculously low price. By educating the small forest and woodlot owner regarding values and markets and thus enabling him to reap a large measure of the profit himself, the State College of Forestry feels that it is not only fulfilling its obligations to the citizens of New York, but is rendering the land problem much easier of solution by making tree culture upon the non-agricultural areas popular and profitable.

> In the past, the difficulty in the way of the small timber owner who desired to market his products direct to the consumer lay, not only in his ignorance of markets and values, but also in the limited amount of each species he had for sale. A man possessing one-half million feet ready for the axe could doubtless find a purchaser for all his material. To the owner of twenty acres of woodland, where some of the more valuable species may yield considerably less than carload lots, the problem of finding a profitable market is one rather difficult to solve. The best

answer seems to be in local sales or some form of cooperative marketing.* (See p. 99.) In certain cases owners of adjoining or nearby woodlots can plan to log and saw at the same time. The larger cut thus obtained will permit the securing of a selling agent or at least enable a better bargain to be driven.

While the actual felling and skidding operations and the hauling of the sawn lumber are parts of the manufacture of lumber which the landowner should do with his own teams and labor, if possible, there are many cases where it cannot be done. In a busy dairy farm, for example, there may be little if any spare time in the winter, and besides the equipment may be lacking. In such cases true farm economy may demand the selling of the standing trees at a fair price rather than the purchasing of equipment and carrying on the work with unskilled, hired labor. In such a case the aims should be:

1. To get a fair price for the timber.
2. To see that the purchaser removes the mature, defective and undesirable trees without injuring the young growth and that the woodlot is left comparatively free from slash and with fire risk at a minimum.

Regarding prices, the value of any standing timber depends upon;

1. Species—whether in demand or not.
2. Condition—size and soundness.
3. Situation—distance from mill or railroad. Even the most desirable timber will bring but a small price if the logging and hauling charges eat up the bulk of the sale price.

All of the above must be taken into consideration in fixing a price per thousand on the stump.

In regions where there is a great deal of woodlot logging the average price received for standing timber can usually be obtained by inquiry among neighbors. Usually there is an accepted rate—maximum and minimum—for the various species, depending upon the hauling distance. In such a case it

* At the present, on account of the extreme demand for lumber of all sorts, it is possible in certain parts of the State to sell such species as ash, maple, etc., cut into logs and loaded on cars. This is extremely simple marketing for species needed, but whether it will continue after the present demand subsides remains to be seen.

is merely a question of setting a fair price and holding out until that price is obtained.

> The writer once estimated a woodlot owned by a city man for which the sum of $300 had been offered *for all of the timber it contained.* A day and a half spent in marking the over-mature chestnut, oak and hemlock disclosed that there was about 100,000 board feet of timber contained in trees which had practically ceased growing and should be removed for the good of the stand. On account of the large size of the timber and the proximity to market, a price of $10 per thousand was set. When the owner reported this sum to the would-be purchaser, he stated in emphatic terms that "he always knew foresters were a crazy lot, but as a special concession he would give $450 for the marked trees," about *one-third of the stand.* The offer was refused. In a few weeks he raised it to $600, then to $800, and finally paid $1,000 cash for *one-third the timber,* all of which he had nearly bought for $300. It pays to know how much the timber is worth.

In some parts of the State reliable estimators are to be found who make a business of cruising woodlots at a certain rate per day. If such men are available, care should be taken to select a man who is truly expert and one who has no business relations with the possible purchaser.*

The safest and most satisfactory way, however, is for each owner to compute the value of his products, check this figure against all reliable data and then hold until the minimum price is received. Such computations are extremely helpful whether or not the services of an expert are enlisted, as errors may be detected by the second computation.

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* The New York State College of Forestry at Syracuse is willing and ready to give general advice free of charge concerning the methods of cutting, protecting the woodlot, etc., but it does not feel justified in sending out members of the staff for the sole purpose of valuing timber land. Ordinarily, however, the College can direct interested owners to reliable and experienced men who can advise them regarding the amount and value of their forest products.

Stumpage prices

The steps in figuring the stumpage values of the various species might be outlined as follows:

From the selling price of the manufactured product deduct:

The cost of felling and skidding the logs.
The cost of sawing.
The cost of stacking.
The cost of hauling lumber.
Freight charges.

And in addition, 20 to 25 per cent of the manufacturing and selling cost for the logger's profit. The remainder should be the price which the timber should command standing on the stump.*

A stumpage price for a pine stand seventy years old would be computed in this fashion:

1. The average price paid for mill run pine delivered at the plants of several nearby consumers could be obtained either by correspondence with the possible purchasers or from the New York State College of Forestry at Syracuse. This is at present about $50 per M. Bulletin No. 1, Wood-using Industries of New York, published by the College, gives the average prices delivered for the year 1910. A letter to the Utilization Department of the College will bring the current prices.
2. Freight charges could be computed by ascertaining the rate per hundred pounds to the nearest mill, say 12½ cents per hundred, and multiplying by 2800, the air dry weight of 1000 board feet of pine obtained from table on p. 131. The freight charges in this case would be $3.50 per M.
3. The average manufacturing costs might be obtained by inquiry in the locality in question. If information is lacking, the average cost (say $15 per M) might be used.
4. For profit and selling expense, the fourth of a moderate, and one-fifth of a high, manufacturing cost should be added to the charges. In this case $\frac{\$15.00}{5} = \$3.00$*
5. Cost of hauling logs, say three miles, from woods to sawmill, $6.00 per M.
6. Cost of skidding, $2.50 per M.
7. Cost of felling and bucking, $3.50 per M.

* The allowance for a profit is perfectly legitimate since supervision and selling costs must come out of this item. The above amount is none too large since in addition extraordinary expenses and losses of various kinds must be paid from this sum. Many mill operators will not touch a woodlot unless the purchase price will show them a minimum profit of $2.50 per M.

8. The selling price of the timber at the mill minus the sum of the various charges equals the stumpage price which the owner should receive, e. g.:

Price received f. o. b. mill for white pine			$50 00
Mill costs, freight charges, etc...	$21 50		
Logging costs	12 00		
		$33 50	
Stumpage price		16 50	
		$50 00	$50 00

In December, 1919, the following statement was obtained as the approximate prices of sawn lumber f. o. b. mill run, prevailing throughout the latter part of that year:

	Per M.		Per M.
Hemlock	$55 00	Basswood	$65 00
Oak	75 00	Ash	70 00
Maple	75 00	Cherry	75 00
Chestnut	70 00	Yellow birch	40 00
Beech	40 00	White pine	50 00
Elm	40 00	Spruce	40 00

A stumpage value computed in this way may still be too low, as the unusual quality of the standing timber—its large size and freedom from knots—may command a price considerably above the average. However, a woodlot owner with such a price per thousand in mind would be in an infinitely better position than a man who merely accepts a lump sum for all the timber the operator wishes to cut from his woodlot without having the faintest idea of whether there are 100,000 or 400,000 board feet of standing timber and whether the operator is going to obtain a profit of three dollars or eight dollars per thousand for his trees. Such a price might be considered the rock bottom figure and the asking price might be set considerably higher.

Contract

Having fixed upon a minimum price, a bargain may be struck. However, if the would-be purchaser refuses to pay the price, it would be wise to hold out, since the condition of even mature timber does not greatly deteriorate in two to three years, and by that time the prices doubtless would have advanced still further. One advantage of the forest crop is that it can be sold when the price is right, and "holding over" two or three years

will not cause appreciable deterioration or depreciation as in the case of most farm crops.*

When the sale has been made, a contract, or at least a written agreement, should be drawn up. In this instance, the services of a lawyer are likely to be helpful, as the loss of a few thousand board feet will amount to more than the fees for drawing up such a simple document. Such a contract or agreement should include the following points:

1. None but marked trees shall be cut. Double stumpage shall be charged for unmarked trees which the chopper removes. It is quite a common trick for choppers to "lodge" a marked tree in an unmarked tree of good size in order to fell the big one. Foresters always blaze a tree to be removed about four feet from the ground and again upon the stump, preferably using an initialled marking axe or hatchet. After the operation is finished it is quite simple to check up the unmarked trees removed.

2. All timber felled shall be paid for at a given price per thousand, whether removed or used, the owner to do the scaling. This will mean greater care in felling to prevent breakage.

3. The log rule to be used in measuring the logs should be specified (see Appendix).

4. Reasonable care shall be used in felling and skidding trees that no unnecessary damage be done to the reproduction. If there are large groups of fine young saplings which carelessness might irretrievably injure, a penalty of so much per tree damaged should be included if possible.

5. Low stumps and closely used tops should be demanded. This clause not only provides for larger revenue, but also leaves the lot in much better condition.

6. The question of brush disposal should be provided for. In case the full price demanded for the stumpage can-

* In regions where there is little woodlot logging and little competition among buyers, it is not wise to hold out for too stiff a price. If the operator cannot get stumpage for his mill he may move some distance away, in which case there might be no opportunity for a sale for some time to come. A fair price and a fair profit should be the aim.

not be obtained, the operator may agree to pile and burn the brush, which operation is worth from twenty cents to fifty cents per thousand. This will save the owner that much labor and expense later on.

7. Payment of stumpage price should be stipulated either in advance or in installments as fast as the timber is cut and *before it is removed from the property.* In case of a financial failure or breach of contract, the material is still in the owner's possession.

8. The purchaser should agree to use all care regarding forest fire, and to extinguish at his own expense all fires which may occur during the operation.

9. In case of dispute each party may select a referee, who will choose a third, and the majority decision of these three men shall be binding.

Other clauses may be included to cover special cases, but a contract or agreement drawn up to cover the above points will usually prove satisfactory, and the owner will find his woodland left in good growing and reproducing condition when the operation is finished.

Selling the Logs

Where equipment and labor for logging are available, but the forest owner has neither the inclination nor the time to supervise the sawing and marketing, he may agree to deliver logs from the stump to the mill, receiving a contract price for them; the price should vary according to the species and the quality of the timber. While in certain parts of the country *logs* are graded, the experience necessary to grade accurately several thousand logs is rather beyond the average owner. If the timber to be sold is of extra size and quality, it would be much easier and simpler to add five dollars to eight dollars per thousand to the stumpage price obtained by deducting logging costs, etc., from selling price. (Page 92.) In case of extremely large and fine timber, to secure an experienced estimator might be money well expended. (The oldest and largest trees are sometimes the most defective, however, so that size alone may not be a safe criterion.)

FIGURE 12. LOGS PILED IN ROLLWAY READY FOR MILL SET UP. By cutting, skidding and hauling logs himself, the landowner can utilize idle time for help and teams, and insure minimum damage to young growth in felling.

By fixing a fair price per thousand for his forest products, the average owner will be assured of a good return, provided he knows how much he has to sell. This information may be obtained either from a "cut and leave" estimate of the standing timber or by measuring the contents of the trees after they are felled and cut into log lengths. This process of measuring logs is called "scaling" and may be performed either in the woods as fast as the trees are felled and cut into log lengths or a scaler may be stationed at the mill rollway. In either case, each log should be marked for identification so that it will not be measured again.

Scaling

The contents of logs in board feet are obtained by the use of a scale rule, a flat hickory stick usually tipped with metal upon which numbers are stamped or burned.*

The stick is applied to the *small end* of the log and the diameter is measured to the nearest inch (*i. e.,* a log 9.4 inches is scaled as a nine-inch log; one 9.6 as a ten-inch log) *inside the bark.* The contents of the log are then read from the stick, which shows, for instance, how many board feet are contained in a log nine inches at the small end and twelve feet long. (The ordinary scale rule reads from six or eight inches to thirty-six inches in diameter, and even log lengths from eight to twenty feet.)

Such measurement sounds extremely simple, and so it would be if each log were perfect in form and free from defects. In practice, however, wide experience is needed to be a good scaler, since proper allowance must be made for interior defects, judging only from exterior signs. Unless the timber is unusually defective, the ordinary over-run will make up for average defects. Logs usually saw out from 10 to 25 per cent more lumber than the log scale gave them. This difference is known as the over-run. In some cases, a lump deduction from the total scale is made for hidden defects, so that by scaling each log as

* In case it is not possible to obtain a scale stick, an ordinary yardstick may be used and the dimensions of each log recorded in a book. On reaching home the contents according to the proper log rule may be worked out by the use of the tables in the Appendix.

sound and then throwing off from 5 to 20 per cent of the volume in board feet, depending upon the age and condition of the timber, a fair allowance may be made.

Which scale or log rule to use in measuring timber is a point which should be clearly agreed upon, preferably in the contract. There are approximately two score log rules in the United States, and some show from 15 to 25 per cent more or less than others. In the Adirondacks, the Adirondack market or Standard is customarily used—a log nineteen inches in diameter and thirteen feet long being taken as the unit or standard. This is considered to contain about 200 board feet, and the ratios of three markets to the cord and five markets to the thousand are commonly accepted.*

For Central New York, the Scribner rule is quite widely accepted, and yields comparatively good results. While quite liberal on small logs, its value for sticks over twenty-eight inches in diameter is rather conservative, yet with the sawing practice of the average portable mill, its figures give a close idea of the sawn lumber obtained. Two log rules called the International and Champlain are conceded to be more nearly correct mathematically, yet the board foot contents they give would be rather difficult for a portable mill to secure. All in all the Scribner rule will give fair and just results.

Selling Sawn Lumber

In certain cases owners of good-sized woodlots may wish to carry a lumbering project through from stump to market. In such instances actual selling of the manufactured lumber is the part likely to cause the greatest difficulty to the average man since the manufacturers and lumber dealer generally buy from mill operators or jobbers who have been in the game for years and who are thoroughly acquainted with markets, freight rates, prices, discounts, etc.

(The Utilization Department of the New York State College of Forestry at Syracuse, publishes each month a

* These ratios only hold true for logs running from 18 to 24 inches in diameter. Five standards of smaller logs will not saw out a thousand board feet, i. e., it takes 13.7 standards of eight-inch logs to yield 1,000 board feet of sawn lumber.

FIGURE 13. SCALING LOGS CUT FROM A FARM WOODLOT. The practice of measuring or scaling logs can be most easily and accurately done as the logs are being skidded into the piles called rollways.

Utilization Bulletin in which are listed amounts and sizes of various species which the owners throughout the State desire to buy or sell. This bulletin is distributed to a wide clientele of consumers and manufacturers of lumber, and frequent sales are made in this way. Any citizen of the State may avail himself of this selling service by writing the Utilization Department, New York State College of Forestry, Syracuse, N. Y.)

Uses of Different Species

The first question which confronts an owner is what are my products to be used for? Will they furnish material for building purposes or can they be most profitably marketed as pulp stock, etc.? In the Appendix will be found a list of the principal uses to which the more common woods of New York are put.

Having learned the forms in which the various species to be cut reach the market, the next step is to get in touch with the nearest producer of these articles. A list of manufacturers of wood products may then be consulted and *those nearest home* written to first, since the *nearer the market the less will be the freight rate.* A brief business-like letter should be written stating that there is for sale so many thousand board feet of hemlock, so much maple, etc., etc., giving the maximum and minimum log diameters and a general idea of the quality of the logs, how much will run clear, etc. The price could either be set or an offer asked. In any case, the seller should have clearly in mind the minimum price he will accept.

Such an inquiry should be started before even the felling is commenced and certainly before the logs are sawed, since very often, better prices may be obtained by sawing the logs in the sizes desired. (This is especially true if grading is done at the mill.) Upon the receipt of an offer, the credit and standing of the would-be purchaser should be investigated if a large sale on credit is contemplated.

Another point worth remembering is to keep a second possible purchaser in view in case the first withdraws his bid while the lumber is in transit.*

Summary

To summarize the steps necessary to dispose profitably of woodlot products by the private owner, the steps would be as follows:

1. Inspect the woodlot and mark the mature and undesirable trees for removal.
2. Ascertain the approximate amount of each species to be harvested by means of a "cut and leave" estimate. Arrangements for sawing, piling or any of the other parts of the logging job which are to be done on contract should be concluded at this time, and the cost and specifications should be set down in writing.
3. From list of "Uses" the articles and products made from each species may be learned.
4. By writing to four or five of the nearest and largest manufacturers found in a list of manufacturers and consumers†, a sale may be made to the consumer direct and the full "delivered price" obtained rather than selling first to a jobber.

In writing to these manufacturers, a brief business-like letter should be the rule, typewritten, if possible. The amount of each species should be stated, the size of the logs, and the quality, stating that the material will be *"sawed to bill."*

Upon the receipt of an offer or the acceptance of the quoted price, terms should be arranged and the sawing may be then safely started, with the assurance that all the material will be sold, and the maximum profit assured the owner of the timber.

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* A prominent portable mill operator, after several disastrous experiences with small manufacturers, makes it a point to arrive at the point of delivery when the car is opened. On several occasions, unscrupulous purchasers wired him that "after partially unloading the car it was found that the grades were not up to standard and they were holding the shipment awaiting his instructions." In such cases he had induced them to accept the shipment by reducing the price several dollars per thousand, which was exactly what they had planned. After several such experiences the mill operator if possible kept two purchasers on the string for each shipment and was present when the car was opened. In case this trick was tried he would order the car resealed and ship it to the other customer rather than suffer the loss.

† See Wood Utilization Directory of New York State, Technical Publication No. 6, Vol. xvii, No. 5, New York State College of Forestry, Syracuse, N. Y., 1917.

Community Marketing

The above plan for disposing of woodlot products may be more difficult than it appears, or at least it will take more time than the brief description suggests. Men not of a business turn of mind or owners of small lots upon which only limited amounts of timber stand may find certain obstacles in the way of direct or individual marketing to the consumer. The difficulty of marketing small amounts of valuable species has been previously referred to, and a man having 6,000 board feet of black cherry and 8,000 feet of white ash may have a rather hard time in finding a purchaser at a good figure. To such owners, the idea of group or community or cooperative marketing, in one of its various phases, would be most welcome. This idea of pooling the interests of several or several score producers of farm and garden crops is not a new one. It has long been discussed, and at present countless instances of creameries and fruit organizations, purchasing associations, etc., managed upon a cooperative basis with striking success can be cited. The recent victory of the New York farmers in obtaining a living price for their milk proves what can be done if the producers will only assist each other. Timber, being a soil product, could and should be marketed through the same machinery, and being a non-perishable crop, has decided advantages when once the markets and values are known.

What forms of community cooperation will help the small woodlot owner in marketing his forest products direct to the consumer with a maximum of profit? Several schemes may be outlined, one of which might fit the conditions in a given community. They represent possible solutions to the marketing question which for some years has engaged the attention of foresters.*

For large forest owners, or men able and ready to market their own products the process has been previously described. For owners of small tracts and men who have neither the time nor the ability to earch out markets for their woodlot products, the following methods of selling direct to the consumer with maximum profit might be suggested:

* Cooperative Marketing of Woodlot Products. Proceedings of Society of American Foresters, 1914, Vol. 9, p. 303.

1. *Selling by paid agent.* If several men would cut over their woodland at the same time by pooling their output, they would have enough material for sale to warrant the hiring of a man who would sell their products on commission.

In such a case, the College would be entirely willing to advise the owners, regarding the prevailing prices, would carry a list of the timber for sale upon its regular monthly list and would advise regarding the best methods of advertising the material, etc.

The selling agent in this case should be a man who is acquainted with the lumber business (if such can be found who will work on commission), and his selling commission on the yield of several woodlots would make it worth his while to undertake the sale and 3 to 5 per cent commission, depending upon the demand for the species, would be fair.

One plan that has been suggested is to have the County Agent act as the business manager for the farmers he serves, and devote more of his time to the selling end, both of field and forest products. In fact, it is quite possible to foresee that the farm bureau could be developed into a rural chamber of commerce, promoting the business end of farm management.

The Farm Bureau agents in this State are, as a rule, thoroughly trained in science, and the general principles of forest management can be easily grasped by such a body of men. The New York State College of Forestry at Syracuse has offered in the past, and now offers full cooperation, in assisting all Farm Bureaus to grow and market the products from the farm woodlots of the State, in order that the rural population may derive the maximum financial returns.

2. *Selling through cooperative associations.* In many parts of the State, cooperative associations are rapidly coming into existence. These associations represent various degrees of efficiency and cooperation. In some instances they exist solely for purchase, supplying members with seed, fertilizer, feed, etc., at reduced rates, obtaining a discount through wholesale purchases.

Other associations sell as well as buy for their members, and to an organization like this, it is but a step from selling potatoes and fruit in the fall to selling cordwood, railroad ties and lumber in the winter months. The selling of woodlot products, it is true, requires a little different knowledge, but a man with the requisite business experience to market successfully a carload of apples could soon pick up the methods of marketing five carloads of basswood and twenty carloads of maple, etc. The College of Forestry gladly offers its assistance to managers of such cooperative associations in finding desirable markets.

> The Grange in some parts of the State is the strong central organization and the best medium for undertaking such a cooperative marketing project. The idea of community woodyards has been put forward where men could deliver a few thousand board feet of lumber in the log; to have the logs sawed, the lumber graded and sold to his credit. This same idea works excellently with fruit and potatoes, and since the entire energy of the land owner is devoted to growing, and the marketing is done by experts, the best results in gross yield and financial profits may be obtained.
>
> The College of Forestry for the past eight years has been actively cooperating with the State Grange in its educational campaign, and believes that this organization, so rapidly increasing in influence, can materially aid the forestry cause within the State by assisting in the marketing of woodlot products. A profitable woodlot means a deeper interest in good forestry practice.

The above mentioned schemes may seem rather too advanced for certain communities, yet it is simply extending to the woodlot owner the cooperative marketing idea launched with such success by the fruit growers of the West, and now being adopted by fruit and truck growers in this State. Both plans simply mean broadening the scope of organizations now in existence; the further perfecting of machinery now in actual operation.

3. *Selling stumpage to registered operators.* Yet another plan may seem more feasible in the immediate future. No man begrudges paying a fair wage nor fair compensation for services

actually rendered. The chief objection against the present inefficient scheme of marketing foodstuffs and woodlot products is that there are too many profits paid to men who do little or nothing. A legitimate charge for the manufacture and sale of a stand of chestnut poles, for example, would not be begrudged provided the land owner felt confident that the man doing the cutting and selling was both capable and honest.

At the present time, there are several graduates of the College of Forestry, or trained foresters of other schools, who are operating portable saw mills within the State. With the understanding that these men must, in every instance, cut the woodlots with the idea of a future crop in mind (or explicitly tell the owner that the method he has in view is straight lumbering rather than forestry); must properly dispose of the brush, and most important of all, must pay the owner a fair price per thousand for his standing timber, the College will recommend to woodlot and small forest owners the members of such a select class of operators. This in reality is not *direct,* personal marketing, yet is a plan providing for more profitable yields from the woodlot, and at the same time should in a few decades mean far better forest crops upon the non-agricultural portions of New York farms.

Whichever of the above schemes is used, or if an entirely original marketing plan is used, the really important thing is to cut and market the timber from the farm woodlot with a definite object in view. This should be to produce tree crops of increasing technical value as time passes, and at the same time, to have the financial yield from the non-agricultural portions of the farms of New York steadily appreciated. No state or nation can permanently prosper that does not care for its soil and both forestry and agriculture separate, yet interdependent, must be practised to the full if the Empire State is to flourish during the coming generations.

CHAPTER VI

RESULTS OF WOODLOT MANAGEMENT

Cost of Forestry

Woodland owned in connection with a farm or country estate is ordinarily managed with one of two ends in view—either:

Aesthetic, the beautifying of the property through the presence of forest growth; or

Commercial, the raising of timber for profit where successive crops of trees are grown primarily for the cash proceeds received from their sale. It is undoubtedly true that any growing forest is attractive, and so adds to the appearance of the property, but, in the latter case, the species are selected and favored solely with technical value in mind. In both instances the land growing the trees and the trees themselves represent capital which if not invested in forest land could be invested in bonds, mortgages, etc., and then would be yielding a cash return.

If a grove or park forest upon an estate is maintained for its beauty alone, the pleasure derived must be worth the income that might be obtained from the investment of the forest capital it represents. Usually it is worth many times that sum and the owner would often rather lose his house than his woodland, since the former could be rebuilt in a year, while the trees could not be replaced in a century. According to the same reasoning, a woodlot should yield its return principally in valuable forest products, and since it is a piece of soil needed for utilitarian purposes, it should be ranked as a producing portion of the farm and its income carefully computed.

The largest immediate return from woodland is obtained by *destructive lumbering;* by cutting the woodland clean, and then abandoning it to fire and weeds, for several decades. Such management is comparable to the system of land tillage often referred to as "Soil Mining," cropping the land year after year with no thought of putting anything back in the form of manures or fertilizers, a system which destroys both local and

national prosperity in the long run. Both of these systems of land management unfortunately have been far too widely practiced in the United States and in New York. Both were undesirable enough when vast stretches of virgin forests and enormous areas of new land were then available for, when the old lands were stripped and exhausted the lumberman or farmer could move to a new region. At present, this country stands at the threshold of a new era. The period of free land has passed, the end of the virgin forests is in sight, and each state, each individual, must develop every resource with a shrewd eye to the future.

Just as conservative agriculture means a smaller present income owing to money spent for fertilizers, etc., so does the practice of forestry mean reduced present profit for the purpose of increasing future returns.* It means foregoing present profits by leaving seed trees and young fast-growing trees and often the reinvesting of a portion of the income in a profitable business. Let it not be thought that forestry, the management of non-agricultural soils for *repeated* tree crops costs nothing. It does, but it means putting aside one dollar to-day and reaping ten at the end of the rotation.

Regulating the Cut

In countries where forest management has long been practiced, the height of the forester's ambition is to make his forest "normal." That is, by carefully calculated plans carried out over a period of years, eventually the forest may, for the given rotation and soil, possess exactly the right proportion of age classes; may have exactly the right amount of growing stock and may be producing just the right amount of new wood (increment) each year. The process of transforming an abnormal into a normal forest by means of proper cuttings is called *regulation.*

* Continental experience proves that in a well-managed forest not only does the amount of timber steadily increase but the quality improves all of the time. A record for the last half of the past century for the State forests of Saxony showed that while the amount cut per year doubled during that period, not only did the forest capital increase 16 per cent but the amount of the crop which yielded saw logs increased from 11 to 54 per cent. The gross income increased 234 per cent and the net revenue over 80 per cent. Economics of Forestry, p. 49, by Dr. B. E. Fernow.

The above strict interpretation of a normal forest has little importance for the average woodlot or small forest owner in this country. For such a man, regulation means limiting the cut to the growth, and while the increment should be made as great as possible, yet the presence of age classes in exact amount is beyond his possibilities. Nor in practice is it always desirable to cut an equal amount each year. In years of high prices it may be good financial management to cut heavily, and then do no cutting whatever for several years. In practically every case, the amount cut by the small owner should be largely governed by market conditions, and occasionally when the cut of timber really mature is limited, it may be necessary to remove some sticks not quite mature in order to obtain an amount sufficient to make a sale possible. As a rule, the amount cut in a year or decade should not exceed the amount grown in that period.

In the typical woodlot, the first step in the way of building up a rundown stand would be to remove the over-mature and diseased, decrepit specimens. This might be done primarily for the purpose of harvesting the old veterans before they completely decay, yet such a cutting would serve to increase the increment as a result of replacing old, slow-going trees with young, thrifty reproduction and by giving more light to the middle-aged and young trees remaining. In addition a sanitary

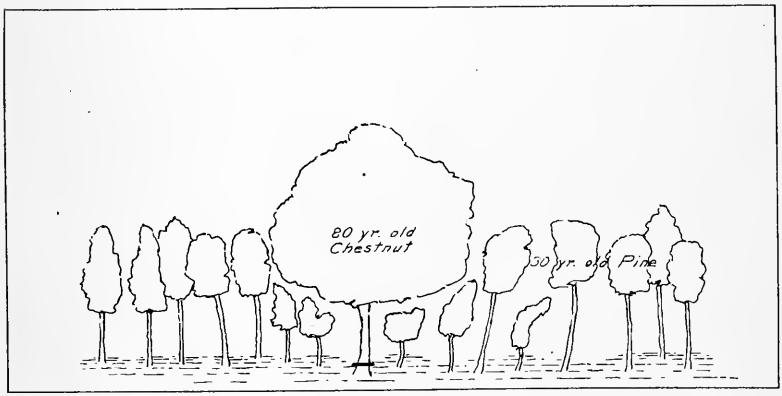

PLATE 16. LIBERATION CUTTING. The removal of the wide-spreading "wolf tree," the eighty-year old chestnut, will liberate the crowded and overtopped thirty-year old pine and greatly improve the condition of the forest growth.

cleaning would result, since the removal of diseased trees would check the dissemination of fungus spores, etc. Such a preliminary cutting could be followed from time to time by periodic cuttings in which the mature trees could be taken out singly or in groups. However, the owner should use some plan whereby he cuts no more than the amount laid on during the period, unless he desires to add to his increment by planting.

Roth* advises dividing the woodlot into, say, ten cutting areas and removing about one-fourth the total volume from each area each year, and at the end of the tenth year plot number one could again be cut over. Such a plan would give a fixed annual cut, and by favoring the faster growing species, and occasionally planting up openings with rapid-growing conifers, the increment could be further increased.

The above method would provide a system of harvesting the forest crops, but a check should be provided regarding the amount of growth. After the first cutting has removed the old veterans, the average yearly growth of the remainder could be found by dividing the number of board feet standing upon an acre by the average age of the stand obtained by felling several average trees and counting the rings. This result would be a highly conservative idea of the volume which the forest could produce each year. By insisting that the periodic cuttings recurring, for instance, every five years, should not remove more than five times the amount of the average annual growth, so computed $(\frac{\text{total growth}}{\text{total age}})$ overcutting will be prevented. Such a check, while rough, will doubtless serve for a few periods, and by that time the increment should have markedly increased when a more exact method might be required.

Rotations

The length of time elapsing from the beginning of a forest until the time the crop is harvested is called the rotation. The length of this period is determined by several factors.

In some instances it is desired to cut the forest at a time when it can best reproduce itself. This is called the Silvicultural Rotation.

* Forest Regulation, by Filibert Roth, p. 159.

Or the forest crop may be harvested when the net return—the final cash yield less the value of the land, planting costs, etc., computed at compound interest up to the time, will be the highest possible interest rate on the investment.

Financial Rotation

> On account of the laws of compound interest, a certain forest crop may yield 5½ per cent compounded at sixty years, but owing to the rapid increase of the sum representing the planting cost, land value, taxes, etc., during the next thirty years, by the time ninety years is reached the investment might not yield more than 4 per cent.

In most cases of woodlot management, it is the technological rotation—the time necessary to produce material of a given size—that is of prime importance.

For reasons given below, the private owner in this country will be compelled to grow the smaller sized timber, as he cannot afford to wait a long time for his dividend, nor can he afford the low interest rate on his forest investment which a long rotation demands.

The states and the federal government alone will be able to grow large timbers, and the coming generations will be compelled to use much smaller timber and of decidedly inferior quality compared with what we use to-day.

According to Roth,* the following rotations would hold for some of the principal products:

Cordwood. Rarely grown as a crop in itself. The bulk of cordwood now coming upon the market is from the tops and branches left after a lumbering operation. (Throughout the lower Hudson valley where cordwood for the brick yards has been an important crop for many years, it was customary to clear out the sprout hardwoods every twenty to twenty-five years.)

Pulpwood. Of late years, trees of all sizes have been turned into pulp on account of the extreme demand for paper stock. Native spruce or balsam fir from plantations can probably be cut at fifty to sixty years with best results. There are indica-

* Forest Regulation, by Filibert Roth, p. 109.

tions that the European or Norway spruce may grow more rapidly than the native species, thus somewhat shortening the above rotation. European larch and Scotch pine will probably yield pulp stock in thirty to forty years.

Railway ties, telephone poles, etc. The rotation necessary to produce these products varies widely with the species. Chestnut was considered to produce its best yields, both financially and from the standpoint of largest tie production, at about fifty-five years,* while white cedar poles may take 150 years.

Red oak, which will probably supplant chestnut as the tie tree of the East will take a few years longer, about sixty to sixty-five years.

Saw timber. The saw timber now coming upon the market was produced at no cost and the American lumberman has been harvesting the growth of centuries. (One authority estimates that it took 200 to 250 years to produce the average tree furnishing lumber for the market to-day.)

European experience proves that when forest crops are grown artificially, large-sized timber largely disappears as the cost of production (figured upon a compound interest basis) is excessive.

For saw timber, Roth† estimates that twelve inches breast high will prove the minimum diameter for saw timber, and naturally the time to produce a tree of this size will vary according to species and site quality. The range would be as follows:‡

40 years or less:
Poplar, soft maple and elm on moist fertile lands.

40–60 years:
White ash, red oak, chestnut, elm, basswood and white pine (for box and barnboard stock).

60–80 years:
Red pine, white pine (for interior trim, etc.), hickory and tulip poplar.

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* Forest Service Bulletin No. 53, Chestnut in Southern Maryland.

† Forest Regulation, p. 111.

‡ To produce saw timber even on the best sites early thinnings would be highly desirable in order that undue competition could be reduced as soon as possible.

Trees like red spruce, hemlock, beech, birch and hard maple would take anywhere from 90 to 120 years to reach saw log size, and the average woodlot owner would not start out with the idea of growing such a long-time crop as any of the above. As single trees or small groups in the stand, such species might be encouraged for sake of variety, but for saw purposes, etc., the major crop should be composed of the faster growing species.

Shortening the Rotations

The time element in the past has been one of the greatest drawbacks to the practice of forestry by the individual, for the average owner has felt that only the State or corporations like water companies and pulp companies having a continuous existence could afford to wait for the harvest. If methods of forest management can be instituted which will shorten the rotation so that the investor starting early may receive some returns during his life or at least have a handsome return accrue to the next generation, the practice of forestry by the individual land owners will be much more widespread.*

Other factors which have worked against private forestry are the limited negotiability of half-grown timber in the average community and the danger from fire. With each passing year the effect of the educational campaign advocating the proper protection of our forest areas is becoming more apparent and before very long, a large part of this risk will be eliminated, since individuals and communities will strive together to stamp out the fire danger.

Concerning negotiability, the decrease in amount of certain kinds of stumpage is causing a marked appreciation in values of standing timber.

In certain parts of this State where markets are unusually good, half-grown pine timber, for instance, can be readily sold at a fair price, since far-seeing men realize the

* The present system of taxation, whereby a crop of trees maturing at fifty years has paid an annual tax every year of its existence, has also deterred many from acquiring land for forestry purposes or from holding on to cutover land. During the New York Legislative sessions of 1919 a series of bills aiming to improve this condition were introduced, but did not pass beyond the committee stage. Another effort is being made during the present session (1920) to lighten the tax load which forest land bears under present conditions.

future value of such seedling land. When forests are both safe and negotiable, they will be rated much higher as good, long-term investments, yielding a fair revenue.

Rotations may be shortened by suiting the species to the site and by early and frequent thinnings which will permit all the available growing energy to be utilized by the marketable trees only. As far as financial considerations are concerned, these thinnings should furnish cash income quite a few years prior to the main harvest. (This is along the same lines as growing corn or beans between the rows of immature apple trees in a young orchard.)

Another method having possibilities is, when starting a plantation, to plant several hundred extra trees like balsam or spruce per acre, and after ten or twelve years, remove the extra trees and sell them for Christmas trees. Several land owners are trying this plan at present, but as yet no definite figures are available. Granting, however, that such an operation were located reasonably close to the cities and larger centers of population, where there is a definite demand for Christmas tree stock, and where the factor of transportation will not consume the larger bulk of the profits, returns of from $200 to $250 per acre net are indicated with reasonable surety on rotations extending over ten to twelve years.

Forests as Investments.

Aside from the lack of negotiability of forest land and standing timber, and the risk, the uncertainty of returns, both as to time and rate per cent, have prevented men of large means from managing forests as real investments. In this country, as in England and on the continent, there is a certain amount of prestige attached to the ownership of large landed properties, yet most of the largest forest owners have bought either for game parks or on speculation, and the idea of managing forest land for the purpose of obtaining a continuous or periodic income has been grasped only by a few foresighted men. The question of how much can you expect such an investment to yield is one that must be answered before forest management, on the basis of sustained yield, becomes general. Undoubtedly good stands of timber of the right species well-located as to railroads or drivable streams, are good investments, since the value

of standing timber, especially in the East, seems certain to rise steadily during the next generation. The purchase of lands for speculative purposes, however, will hardly aid in right use of non-agricultural areas.

Paper and pulp concerns, water companies, etc., will doubtless buy and manage land for sustained yield when they are convinced that such management is profitable.

What interest rate can forests yield, and how much should they be expected to return?

In security markets, the more secure an investment, the smaller is the return, as a rule, and ordinarily long-term investments do not pay as high a rate as short term notes. Forest land, as previously stated, is not an absolutely safe investment at present, nor is it readily sold, but both of these undesirable features are decreasing from year to year. The forest resources of Germany pay a constant revenue of 3 per cent per annum on a capital value of $180 per acre,* and this rate per cent may be taken as the minimum in this country, with the possibility of "extra dividends" due to increased stumpage values.

The planting of cheap land to pine has been recommended as a good investment, but one naturally of long duration. The Massachusetts State Forester† claims that plantations of white pine in that state will yield 5 per cent compound interest, based on 1911 stumpage prices. This figure could then be taken for a maximum. As a general rule, it may be said that the State and federal governments will be justified in practising forestry even though the direct financial returns are no more than 2½ to 4½ per cent. The private owner will not be content with such a small return, consequently must shorten his rotations by every means possible.

In Europe, gross income ranging from four dollars to twelve dollars, and net revenues from two dollars to seven dollars per acre per year were received, before the war. Owing to the wide difference in labor and transportation costs, uncertain demands and unstable market conditions which obtain in this country, it is impossible to draw any parallel from these figures. However, it is an aboslute certainty that money now shrewdly invested in

* Economics of Forestry, by Dr. B. E. Fernow, p. 50.

† Forest Mensuration of White Pine. Mass. State Forester, Boston, Mass., 1911.

forest lands or forest plantations will show an excellent return at the end of the rotation, and every owner of land unsuited to agriculture should set his *idle land* to work with the same zeal that he shows in keeping his *spare cash* always employed.

Financial Returns

It can be definitely shown that the financial returns from investments in forest production approximate those from other forms of investment enterprise, and that forestry can earn between 6 and 7 per cent on the capital invested. Three types of planting are taken as illustration, pure white pine, pure red pine, and an equal mixture of red and white pine. The figures at the basis of this computing were furnished by Prof. R. C. Hawley and O. W. Pfleuger, of the Yale School of Forestry, and are the results of ten years' experience in planting and active forestry practice for the water company at New Haven, Conn. For the purpose of calculation, the interest rate of 5 per cent was adopted arbitrarily. Such rate is slightly in excess at present of that offered by savings bank mortgages and other long-time investments.

BASIS OF CALCULATION

PLANTATION	ESTIMATED YIELD PER ACRE IN BOARD FEET		Estimated value per 1,000 board feet at cutting
	50 years	40 years	
White pine	42,000	28,000	$20.00
Red pine	37,000	25,000	20.00
Red pine and white pine	37,000	25,000	20.00

COSTS*

Establishment and planting	$15.00 per acre
Treatment for white pine weevil (on pure white pine only) expended annually fifth to tenth year	.50 per acre
Cleanings, third year	.50 per acre
Protection	.20 per acre per year
Value of the land devoted to forestry, apart from timber	10.00 per acre
Taxes on forest land apart from the timber	.20 per acre per year
Rate of interest used in calculations	5%
Yield tax on the timber apart from the land at time of rotation	15%

* Based on 1920 prices for the same grade of timber.

FIGURE 14. SECOND GROWTH PINE FOREST. Forests when properly protected against fire constitute investments similar to long term bonds. A planted pine forest will yield approximately 6 per cent per annum with maturity at forty to fifty years.

Plantation	Net income per acre at end of rotation		Rate of interest earned by the investment		Net annual return per acre above 5% interest cost	
	50 years	40 years	50 years	40 years	50 years	40 years
White pine	$315.70	$233.86	6.5	6.9	1.52	1.93
Red pine	273.74	209.56	6.2	6.6	1.31	1.74
Red pine and white pine in equal mixture	273.74	209.56	6.2	6.6	1.31	1.74

It will at once be seen that fifty-year rotation for pure white pine yields $81.84 actual cash return more than a forty-year rotation. But it costs $208.60 more to raise fifty-year-old white pine than forty-year stock, hence the forty-year rotation earns at a rate of interest 0.4 per cent more than the fifty-year rotation.

Similarly in the pure red pine and the mixed red and white plantation for a fifty-year rotation, there is shown an actual cash receipt of $64.18 greater than for the forty-year rotation. But here again, due to the smaller cost of producing forty-year-old trees, the forty-year rotation shows an earned rate of interest 4 per cent greater than for the fifty-year rotation.

A comparison of the pure white pine with the pure red pine and with the mixed plantation shows an excess of $41.96 cash receipts in the fifty-year rotation and $24.30 in the forty-year rotation. The rate of interest earned on that investment is also better by 0.3 per cent for the pure white pine.

It is thus demonstrated that the returns capable from producing timber in plantations makes such enterprises from a financial standpoint quite comparable with other forms of investment. It is to be remembered that the foregoing estimate is based on present prices. Every indication seems to point out the fact that prices for standing timber on the stump, *i. e.*, stumpage values, will increase so that greater returns than those noted above might be expected.

It may be asked how great a value of land can be allowed in forest production. Forestry only concerns itself with lands unsuited for agriculture. Hence the value of the lands devoted to forest production can not be placed at a very high figure.

From a trial of various values, the following values for land were computed as the highest values for forest land that can be allowed without loss, when taxed at a twenty-mill rate, interest figured at 5 per cent.

	Fifty-year rotation	Forty-year rotation
White pine	$23.15	$27.40
Red pine	20.80	24.10
Red and white pine	20.80	24.10

SUMMARY

Undoubtedly, the raising of tree crops is an indispensable part of the nation's land program, and both the State and the private individuals should be encouraged to keep in forest every acre of non-agricultural soil. Such a movement will not only enrich the owner, but, by providing additional supplies of raw material to woodworking establishments, paper plants, etc., will add enormously to the income of skilled workmen, transportation companies, etc., and ultimately will add enormously to the income and prosperity of the whole State.

Forestry no longer appeals for support on sentimental and aesthetic grounds alone. It is a movement essentially economic, and the right use of lands unsuited to agriculture is absolutely essential to the permanent prosperity of the country at large. The State itself should embark in the business of timber production, since it can afford to grow large timber on long rotations which the small owner can not do on account of the length of the rotation required and the fact that he must obtain a larger return for his invested capital. Not only should the State itself grow timber, but it should render all possible help to the small owner of non-agricultural land in order that he may grow and market repeated crops of valuable timber at a good profit, *for no state is any more prosperous than its land-holding and operating element.*

Every acre of land within New York State should be put to its best permanent use. Land that is level and fertile should be tilled and planted to field crops. Land too steep or too stony for tillage should be kept growing repeated crops of timber in

order that future generations may have supplies of an indispensable product and the owners may receive revenue from all their land. The farmer or small woodlot owner is in the best position of all private individuals to practice forestry for the following reasons:

1. He owns the forest land in connection with tilled land, which produces an annual revenue.

2. He has the ordinary equipment in axes, saws, horses, stone boats, sleds, etc.

3. He has the time for woodlot improvements. On only small percentage of farms is the winter season completely filled. During slack periods in the winter, improvement cuttings can be made, while underplantings can be accomplished to the vast improvement of the woodlot before ploughing time in the spring.

4. In many cases, an organization is in existence—either the Grange or the County Bureau—which should assist him in marketing his products with a good profit. The Wood Utilization Service of the College of Forestry is glad to act as a clearing house for the sale of the stumpage and manufactured products owned by the citizens of the State.

From every standpoint forest owners of this type should practice forestry. Briefly summarized, the points to be kept in mind are as follows:

1. The land in the woodlot represents capital as well as the tilled fields. It should be treated as a *producing portion of the farm.*

2. Forest management is merely good business sense applied to a crop of trees. It plans to grow as much valuable timber in the shortest time possible.

3. The cuttings should aim to favor the best species, hence firewood and fence posts should be secured where removals will do the most good rather than where it is easiest to load on the sled.

4. Fires and grazing should be prohibited. Both reduce the dividends from the woodlot.

5. The profit in the entire transaction lies in properly marketing the products of the woodlot. The same energy and business sense should be used in selling a crop of timber as in selling a crop of fruit or potatoes. Trees will not spoil while waiting and will grow while the owner sleeps.

The New York State College of Forestry at Syracuse, as the Institution founded by the State for instruction and research in forestry, offers its cooperation to every land owner and citizen of the Empire State in order that the problem of the right use of land may be solved for the benefit of the present and succeeding generations.

BIBLIOGRAPHY

Berry, James B. Improving the Farm Woodlot. Bulletin, Georgia State College of Agriculture, Athens, Ga., Circular 31, November, 1916.

Blackman, M. W., and Ellis, W. O. Some Insect Enemies of Trees and Ornamental Shrubs. Bulletin No. 6, vol. xvi, No. 26, New York State College of Forestry, Syracuse, N. Y., 1916.

Bray, William L. The Development of Vegetation in New York State. Technical Publication No. 3, vol. xvi, No. 2, New York State College of Forestry, Syracuse, N. Y., 1916.

Brown, Nelson C. The Hardwood Distillation Industry of New York State. Technical Publication No. 5, vol. xvii, No. 1, New York State College of Forestry, Syracuse, N. Y., 1917.

Brown, N. C., and Tryon, H. H. Wood Utilization Directory of New York State. Technical Publication No. 6, vol. xvii, No. 5, New York State College of Forestry, Syracuse, N. Y., 1917.

Cary, Austin.. A Manual for Northern Woodsmen. Harvard University Press, Cambridge, Mass., 1919.

Cheyney, E. G., and Wentling, J. P. The Farm Woodlot. The Macmillan Company, New York, 1914.

Ferguson, John A. Farm Forestry. John Wiley & Sons, Inc., New York, 1916.

Fernow, B. E. Economics of Forestry. Thomas V. Crowell & Co., New York, 1902.

Foster, J. H. Marketing White Pine in New Hampshire. New Hampshire State College of Agriculture, Extension Bulletin No. 3, Durham, N. H., 1914.

Foster, J. H., and Millen, F. H., and Krausz, H. B. Farm Forestry. Agricultural and Mechanical College of Texas, Bulletin 42, College Station, Texas, 1917.

Foster, J. H. Plan for Better Forest Management of Woodlands. Proceedings of American Foresters, July, 1914.

Frothingham, E. H. The Status and Value of Farm Woodlots in the Eastern United States. U. S. Department of Agriculture, Bulletin 481, Washington, D. C., 1917.

Graves, Henry S. Forest Mensuration. John Wiley & Sons, Inc., New York, 1910.

Graves, Henry S. Principles of Handling Woodlands. John Wiley & Sons, Inc., New York, 1914.

Graves, Henry S., and Ziegler, E. A. The Woodsman's Handbook. U. S. Department of Agriculture, Forest Service Bulletin 36, Washington, D. C., 1910.

Graves, Henry S. National Forests and the Farmer. Year Book U. S. Department of Agriculture, 1914.

GRAVES, HENRY S. The Practice of Forestry and the Private Owner. Year Book U. S. Department of Agriculture, 1899.

GRAVES, HENRY S. Private Forestry. U. S. Department of Agriculture, Circular 129, Washington, D. C.

GRAVES, HENRY S., and FISHER, R. T. The Woodlot. U. S. Department of Agriculture, Bulletin 42, Washington, D. C., 1903.

HAWLEY, R. C. Forestry in Southern New England. American Forestry, January, 1920.

HAWLEY, R. C., and HAWES, A. F. Forestry in New England. John Wiley & Sons, Inc., New York, 1912.

JONES, R. C. Farm Forestry in Virginia. Virginia Geological Commission, Office of the State Forester, Bulletin No. 12, University of Virginia, Charlottesville, Va., 1917.

LAMB, G. N., and KRAUSZ, H. B. Industries Using North Carolina Farm Timber. North Carolina State College of Agriculture and Engineering, Extension Circular No. 73, Raleigh, N. C., 1918.

LOVEJOY, P. S. The Segregation of Farm from Forest Land. Journal of Forestry, October, 1919.

MATTOON, W. R., and BARROWS, W. B. Measuring and Marketing Woodlot Products. U. S. Department of Agriculture, Farmers' Bulletin 715, Washington, D. C., 1916.

MOON, F. F. Cooperative Marketing of Woodlot Products. Proceedings of American Foresters, July, 1914.

MOON, F. F. The Book of Forestry. D. Appleton & Co., New York, 1916.

MOON, F. F., and BROWN, N. C. Elements of Forestry. John Wiley & Sons, Inc., New York.

MOON, F. F. Forest Conditions of Warren County, New York. New York Conservation Commission Bulletin No. 6, Albany, N. Y., 1911.

PINCHOT, GIFFORD. The Primer of Forestry, Part I: The Forest. U. S. Department of Agriculture, Farmers' Bulletin 173, Washington, D. C.

PINCHOT, GIFFORD. The Primer of Forestry, Part II: Practical Forestry. U. S. Department of Agriculture, Farmers' Bulletin 358, Washington, D. C.

ROSENBLUTH, R. Woodlot Forestry. New York Conservation Commission Bulletin No. 9, Albany, N. Y., 1913.

ROTH, FILIBERT. Forest Regulation. Michigan Manual of Forestry, vol. 1, F. Roth, Ann Arbor, Mich., 1914.

STEPHEN, J. W. Making Best Use of the Idle Lands in New York. New York State College of Forestry, Circular 19, vol. xvii, No. 25, Syracuse, N. Y., 1917.

STEPHEN, J. W. Basket Willow Culture in New York State. New York State College of Forestry, Circular 18, vol. xvii, No. 24, Syracuse, N. Y., 1918.

SMITH, H. A. The Farm Woodlot Problem. Year Book U. S. Department of Agriculture, 1914.

TILLOTSON, C. R. Care and Improvement of the Woodlot. U. S. Department of Agriculture, Farmers' Bulletin 711, Washington, D. C., 1916.

TOUMEY, JAMES W. Seeding and Planting. John Wiley & Sons, Inc., New York, 1918.

ZON, RAPHAEL. Forests and Water in the Light of Scientific Investigations. Appendix V, Final Report of the National Waterways Commission, p. 226, Washington, D. C., 1905.

———— Reforesting Waste and Cutover Land. New Hampshire Forestry Commission, Bulletin IV, Concord, N. H.

———— The Reforestation of Cutover and Idle Lands in New York. New York State College of Forestry Circular 2, vol. xiii, No. 1-a, Syracuse, N. Y., 1913.

———— Hints for the Woodlot Owner. New York State College of Forestry, Folder 3, Syracuse, N. Y., 1913.

———— Wood Utilization Service. New York State College of Forestry, Folder 8, Syracuse, N. Y., 1916.

———— Forest Mensuration of White Pine. Massachusetts State Forester's Office, Boston, Mass., 1911.

UNITED STATES DEPARTMENT OF AGRICULTURE PUBLICATIONS

The Preservative Treatment of Farm Timber. Farmers' Bulletin 744.

Machinery for Cutting Firewood. Farmers' Bulletin 1023.

Waste Land and Wasted Land on Farms. Farmers' Bulletin 745.

What the Farm Contributes Directly to the Farmer's Living. Farmers' Bulletin 635.

Uses of Chestnut Timber Killed by the Bark Disease. Farmers' Bulletin 528.

The Ashes: Their Characteristics and Management. Department Bulletin 299.

The Commercial Hickories. Forest Service Bulletin 80.

Scrub Pine. Forest Service Bulletin 94.

Forest Planting in the Eastern United States. Department Bulletin 153.

The Status and Value of Farm Woodlots in the Eastern United States. Department Bulletin 481.

How to Pack and Ship Young Forest Trees. Forest Service Circular 55.

How to Transplant Forest Trees. Forest Service Circular 61.

Black Locust. Forest Service Circular 64.

Black Walnut. Forest Service Circular 58.

Norway Spruce. Forest Leaflet 12.

Red Cedar. Forest Leaflet 20.

Protection of Forests from Fire. Forest Service Bulletin 82.

Making Woodlands Profitable in the Southern States. Farmers' Bulletin 1071.

STATE PUBLICATIONS ON FARM FORESTRY

Circulars or bulletins on various phases of farm forestry have been published by many of the States. No attempt is made here to list these publications. Applications from those desiring information about them should be addressed to the following:

New Hampshire—Forestry Commission, State House, Concord, N. H.
Maryland—State Forester, Johns Hopkins University, Baltimore, Md.
West Virginia—Director of Extension, Agricultural College, Morgantown, W. Va.
Kentucky—State Forester, Old State House, Frankfort, Ky.
Tennessee—State Forester, State Geological Survey, Nashville, Tenn.
North Carolina—State Forester, University of North Carolina, Chapel Hill, N. C.; Director of Extension, Agriculutural College, Raleigh, N. C.
South Carolina—Director of Extension, Clemson College, S. C.
Georgia—Department of Forestry, Agricultural College, Athens, Ga.
Florida—Director of Extension, Agricultural College, Gainesville, Fla.
Alabama—Director of Extension, Polytechnic Institute, Auburn, Ala.
Mississippi—Director of Extension, Agricultural College, Miss.
Louisiana—Superintendent of Forestry, Conservation Commission, New Orleans, La.; Director of Extension, Agricultural College, Baton Rouge, La.
Texas—State Forester, College of Agriculture, College Station, Texas.

APPENDIX

TABLES

TABLE 1

SURVEYOR'S MEASURE (LINEAR)

1 link	=	0.01 chain	=	0.66 foot	=	7.92	inches
100 links	=	1.00 chain	=	4 rods	=	66.00	feet
80 chains	=	1.00 mile	=	320 rods	=	5,280	feet

TABLE 2

SURVEYOR'S MEASURE (SQUARE)

1 acre = 160 square rods = 10 square chains = 43,560 square feet.

40 acres = a square whose side is 1,320 feet = 80 rods, 20 chains or ¼ mile in length.

640 acres = 1 square mile or a square whose side is 1 mile.

TABLE 3

USEFUL EQUIVALENTS AND CONVERTING FACTORS*

	Equals	
One cubic foot of round timber	6	board feet
One cord (fuel wood averaging 5″ or less at middle diameter of sticks), size of pile 4 x 4 x 8′	333⅓	board feet
One cord (fuel wood averaging 6″ or more at middle diameter of sticks), size of pile 4 x 4 x 8′	500	board feet
One cord spruce pulp wood	550	board feet
One telephone pole 7″ (diameter at top) x 30′	60	board feet
One telephone pole 9″ (diameter at top) x 30′	100	board feet
One standard railroad tie 6 x 8″ x 8′	30	board feet
One railroad tie 7 x 9″ x 8′	35	board feet
One post 6″ (in diameter) x 7′	7	board feet
One standard cord stacked wood	90	cubic feet

* Taken from "The National Forest Manual" 1915.

APPLICATION OF LOG RULES

Scale only the sound material in each log. First scale the log as sound, taking diameter measurements inside of the bark at the small end of the log, and the length to the nearest even foot. Disregard the excess allowed for trimming length. With the diameter and length gotten, look up the board foot values for the corresponding dimensions in the tabulated log rule accepted for use on that job. This gives the gross scale for the log. If there is no defect, the gross scale automatically becomes the net scale. If defect is present, scale the defective portion *as if it were a log*, and look up its board foot value. Deduct this figure from the gross scale of the log to get the net scale. Only net scale values should be entered into the tally book. In a properly conducted scale, each and every log should be separately examined.

TABLE 4

DOYLE LOG RULE

Top diameter—inches	CONTENTS IN BOARD FEET					
	LENGTH OF LOG IN FEET					
	6	8	10	12	14	16
6	1.5	2.0	2.5	3.0	3.5	4
7	3.4	4.5	5.6	6.8	7.9	9
8	6	8	10	12	14	16
9	9	12	16	19	22	25
10	13	18	22	27	31	36
11	18	24	31	37	43	49
12	24	32	40	48	56	64
13	30	40	51	61	71	81
14	37	50	62	75	87	100
15	45	60	76	91	106	121
16	54	72	90	108	126	144
17	63	84	106	127	148	169
18	73	98	122	147	171	196
19	84	112	141	169	197	225
20	96	128	160	192	224	256
21	108	144	181	217	253	289
22	121	162	202	243	283	324
23	135	180	226	271	316	361
24	150	200	250	300	350	400
25	165	220	276	331	386	441
26	181	242	302	363	423	484
27	198	264	331	397	463	529
28	216	288	360	432	504	576
29	234	312	391	469	547	625
30	253	338	422	507	591	676
31	273	364	456	547	638	729
32	294	392	490	588	686	784
33	315	420	526	631	736	841
34	337	450	562	675	787	900
35	359	480	601	721	841	961
36	383	512	640	768	896	1024
37	408	544	681	817	953	1089
38	433	578	722	867	1011	1156
39	459	612	766	919	1072	1225
40	486	648	810	972	1134	1296

TABLE 5

SCRIBNER DECIMAL C LOG RULE

Top diameter—inches	CONTENTS IN BOARD FEET						
	LENGTH OF LOG IN FEET						
	6	8	10	12	14	16	18
6	5	5	10	10	10	20	20
7	5	10	10	20	20	30	30
8	10	10	20	20	20	30	30
9	10	20	30	30	30	40	40
10	20	30	30	30	40	60	60
11	20	30	40	40	50	70	80
12	30	40	50	60	70	80	90
13	40	50	60	70	80	100	110
14	40	60	70	90	100	110	130
15	50	70	90	110	120	140	160
16	60	80	100	120	140	160	180
17	70	90	120	140	160	180	210
18	80	110	130	160	190	210	240
19	90	120	150	180	210	240	270
20	110	140	170	210	240	280	310
21	120	150	190	230	270	300	340
22	130	170	210	250	290	330	380
23	140	190	230	280	330	380	420
24	150	210	250	300	350	400	450
25	170	230	290	340	400	460	520
26	190	250	310	370	440	500	560
27	210	270	340	400	480	550	620
28	220	290	360	440	510	580	650
29	230	310	380	460	530	610	680
30	250	330	410	490	570	660	740
31	270	360	440	530	620	710	800
32	280	370	460	550	640	740	830
33	290	390	490	590	690	780	880
34	300	400	500	600	700	800	900
35	330	440	550	660	770	880	980
36	350	460	580	690	810	920	1040
37	390	510	640	770	900	1030	1160
38	400	540	670	800	930	1070	1200
39	420	560	700	840	980	1120	1260
40	450	600	750	900	1050	1200	1350

TABLE 6

INTERNATIONAL LOG RULE

Top diameter—inches	CONTENTS OF LOGS IN BOARD FEET*						
	LENGTH OF LOG IN FEET						
	8	10	12	14	16	18	20
6	10	10	15	20	20	25	30
7	15	15	20	25	30	35	45
8	20	25	30	35	45	50	60
9	25	30	40	50	55	65	75
10	30	40	50	60	70	85	95
11	40	50	65	75	90	105	115
12	50	65	75	90	105	125	140
13	60	75	90	110	130	145	165
14	70	90	110	130	150	175	195
15	80	105	125	150	175	200	225
16	95	120	145	170	200	230	260
17	105	135	165	195	225	260	295
18	120	155	185	220	255	295	330
19	135	175	210	250	290	330	370
20	150	195	235	275	320	365	410
21	170	215	260	305	355	405	455
22	185	235	285	340	390	445	500
23	205	260	315	370	430	490	550
24	225	285	345	405	470	535	600
25	245	310	375	445	510	580	650
26	265	335	405	480	555	630	705
27	290	365	440	520	600	735	765
28	310	395	475	560	645	790	825
29	335	425	510	605	695	845	885
30	360	455	550	645	745	905	950

* Based on Sawkerf of one-eighth inch.

TABLE 7

NEW YORK STANDARD DIMICK OR GLENS FALLS RULE*

LENGTH FEET	DIAMETER IN INCHES						
	3	4	5	6	7	8	9
4	.009	.01	.02	.03	.04	.06	.07
5	.01	.02	.03	.04	.05	.07	.08
6	.01	.02	.03	.05	.06	.08	.10
7	.02	.02	.04	.05	.08	.10	.12
8	.02	.02	.04	.06	.09	.11	.14
9	.02	.03	.05	.07	.10	.12	.15
10	.02	.03	.05	.08	.11	.14	.17
11	.03	.03	.06	.08	.12	.15	.19
12	.03	.04	.06	.09	.13	.17	.20
13	.03	.04	.07	.10	.14	.18	.22

LENGTH FEET	DIAMETER IN INCHES						
	10	11	12	13	14	15	16
4	.09	.10	.12	.14	.17	.19	.22
5	.11	.13	.15	.18	.21	.24	.27
6	.13	.16	.18	.22	.25	.29	.33
7	.15	.18	.22	.25	.29	.33	.38
8	.17	.21	.25	.29	.33	.38	.44
9	.19	.24	.28	.33	.37	.43	.49
10	.22	.26	.31	.36	.42	.48	.55
11	.24	.29	.34	.40	.46	.52	.60
12	.26	.31	.37	.43	.50	.57	.66
13	.28	.34	.40	.47	.54	.62	.71

LENGTH FEET	DIAMETER IN INCHES					
	17	18	19	20	21	22
4	.25	.28	.31	.34	.38	.41
5	.31	.35	.38	.43	.47	.52
6	.37	.42	.46	.51	.56	.62
7	.43	.48	.54	.60	.66	.72
8	.49	.55	.62	.68	.75	.82
9	.55	.62	.69	.77	.84	.93
10	.62	.69	.77	.85	.94	1.03
11	.68	.76	.85	.94	1.03	1.13
12	.74	.83	.92	1.02	1.13	1.24
13	.80	.90	1.00	1.11	1.22	1.34

* A Dimick Standard is accepted as the equivalent of a log thirteen feet long and nineteen inches inside the bark at the smaller end.

TABLE 7 — (*Continued*)

Length feet	Diameter in Inches					
	23	24	25	26	27	28
4	.45	.49	.53	.58	.62	.67
5	.57	.62	.67	.72	.78	.83
6	.68	.74	.80	.86	.93	1.00
7	.79	.86	.93	1.01	1.09	1.17
8	.90	.98	1.06	1.15	1.24	1.34
9	1.02	1.11	1.20	1.29	1.40	1.50
10	1.13	1.23	1.33	1.44	1.55	1.67
11	1.24	1.35	1.46	1.58	1.71	1.84
12	1.36	1.48	1.60	1.73	1.86	2.00
13	1.47	1.60	1.73	1.87	2.02	2.17

Length feet	Diameter in Inches					
	29	30	31	32	33	34
4	.72	.77	.82	.87	.93	.98
5	.90	.96	1.02	1.09	1.16	1.23
6	1.08	1.15	1.23	1.31	1.39	1.48
7	1.25	1.34	1.43	1.53	1.63	1.72
8	1.43	1.53	1.64	1.75	1.86	1.97
9	1.61	1.72	1.84	1.97	2.09	2.22
10	1.79	1.92	2.05	2.18	2.32	2.46
11	1.97	2.11	2.25	2.40	2.56	2.71
12	2.15	2.30	2.46	2.62	2.79	2.95
13	2.33	2.49	2.66	2.84	3.02	3.20

Length feet	Diameter in Inches					
	35	36	37	38	39	40
4	1.04	1.10	1.17	1.23	1.30	1.36
5	1.30	1.38	1.46	1.54	1.62	1.70
6	1.56	1.66	1.75	1.85	1.94	2.04
7	1.83	1.93	2.04	2.15	2.27	2.39
8	2.09	2.21	2.33	2.46	2.59	2.73
9	2.35	2.49	2.62	2.77	2.91	3.07
10	2.61	2.76	2.92	3.08	3.24	3.41
11	2.87	3.04	3.21	3.38	3.56	3.75
12	3.13	3.31	3.50	3.69	3.89	4.09
13	3.39	3.59	3.79	4.00	4.21	4.43

TABLE 8

COMPARISON OF LOG RULES

The values given are for 16-foot logs only

TOP DIAMETER INSIDE OF BARK 17 INCHES Inches	CONTENTS — BOARD FEET										
	Scribner	Scribner Decimal C	Doyle	Scribner Doyle	Holland or Maine	Blodgett or New Hampshire	Humphrey or Vermont	Bangor	Cumberland River	Herring	Champlain
6	18	20	4	4	20	26	24	23	17	(19)	22
7	24	30	9	9	31	35	32	27	23	(26)	32
8	32	30	16	16	44	43	43	41	31	34	43
9	42	40	25	25	52	54	53	54	39	43	56
10	54	60	36	36	68	66	67	69	47	53	70
11	64	70	49	49	83	78	80	84	57	65	87
12	79	80	64	64	105	92	96	100	68	77	105
13	97	100	81	81	120	106	112	118	80	91	124
14	114	110	100	100	142	123	131	137	93	107	146
15	142	140	121	121	161	139	149	158	107	124	168
16	159	160	144	144	179	157	171	182	121	142	193
17	185	180	169	169	205	176	192	209	137	162	219
18	213	210	196	196	232	197	216	238	153	183	247
19	240	240	225	225	271	217	240	268	171	206	277
20	280	280	256	256	302	240	267	300	190	230	308
21	304	300	289	289	336	262	293	334	209	256	341
22	334	330	324	324	363	287	323	369	229	284	376
23	377	380	361	361	401	313	352	406	250	313	412
24	404	400	400	400	439	339	384	444	273	344	450
25	459	460	441	441	477	367	416	484	296	377	490
26	500	500	484	484	507	397	451	526	320	411	532
27	548	550	529	529	546	426	485	566	345	447	575
28	582	580	576	582	614	457	523	609	372	485	620
29	609	610	625	609	657	489	560	652	399	525	666
30	657	660	676	657	706	514	600	697	427	567	714
31	710	710	729	710	755	557	640	743	456	616	764
32	736	740	784	736	795	592	683	792	485	655	814
33	784	780	841	784	848	628	725	842	516	703	868
34	800	800	900	800	900	666	771	892	548	752	923
35	876	880	961	876	949	704	816	(950)	581	(800)	980
36	923	920	1,024	923	1,026	744	864	(1,000)	614	(850)	1,038

TABLE 9[1]

Approximate Weights of Various New York Woodland Products[2]

Species	Lumber (per 1,000 Board Feet)			Logs (per 1,000 Board Feet Log Scale, Doyle Rule)[4]						Cordwood, bolts, butts, etc., per cord[3]	
	one inch thick		Rough[3] classed as 1" thick	diameter inside bark at small end							
				12 inches		18 inches		24 inches			
	Green	Air dry		Green	Dry	Green	Dry	Green	Dry	Green	Dry
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Ash, white	4,000	3,500	3,500	11,100	9,700	7,700	6,800	6,600	5,700	4,300	3,800
Basswood	3,400	2,100	2,600	9,500	5,900	6,600	4,100	5,600	3,500	3,700	2,300
Beech	4,600	3,600	4,000	12,700	10,100	8,900	7,000	7,500	6,000	5,000	3,900
Birch, yellow	4,800	3,700	4,000	13,200	10,300	9,200	7,200	7,800	6,100	5,100	4,000
Cherry, black	3,800	3,000	4,000	10,500	8,300	7,300	5,800	6,200	4,900	4,100	3,200
Chestnut	4,600	2,500	2,800	12,600	7,000	8,800	4,900	7,500	4,100	4,900	2,700
Elm, soft	4,000	2,900	3,200	11,200	8,000	7,800	5,600	6,600	4,700	4,400	3,100
Elm, rock	4,600	3,300	3,800	12,600	9,200	8,800	6,400	7,500	5,500	4,900	3,600
Hickory	5,200	4,300	5,000	14,700	11,900	10,300	8,300	8,700	7,000	5,700	4,600
Maple, sugar	4,700	3,600	4,000	12,900	10,000	9,000	7,000	7,600	5,900	5,000	3,900
Maple, red	4,300	3,000	3,000	11,900	8,200	8,300	5,700	7,100	4,900	4,700	3,200
Oak, red	5,400	3,600	3,900	14,800	10,100	10,300	7,000	8,800	6,000	5,800	3,900
Oak, white	5,200	4,000	3,900	14,400	11,000	10,000	7,700	8,500	6,500	5,600	4,300
Yellow poplar	3,200	2,400	2,800	8,800	6,500	6,100	4,500	5,200	3,900	3,400	2,500
White pine	.....	2,800	.....	.....	.....	.....	.....	.....	.....	.....	.....
Walnut	4,300	3,000	4,000	11,900	8,200	8,300	5,700	7,100	4,900	4,700	3,200
Spruce	.....	2,600	.....	.....	.....	.....	.....	.....	.....	.....	.....
Balsam	.....	2,600	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hemlock	.....	2,800	.....	.....	.....	.....	.....	.....	.....	.....	.....
Red pine	.....	3,000	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1] Table based on U. S. Dept. of Agriculture, Bulletin 715.

[2] These weights are not the shipping weights presscribed by any railroad or any State railroad commission.

[3] Weights of rough lumber in this column are official standard weights of the Hardwood Manufacturers' Association of the United States. Rough lumber is usually cut more than one inch thick, to allow for shrinkage in seasoning.

[4] Weights of logs and cordwood computed from A. K. Armstrong's weights of hardwood per cubic foot (90 cubic feet per cord).

APPLICATION OF VOLUME TABLES

A volume table, unlike a log rule, only applies to the given species for which it was made. Hence for every species represented in the field tally sheet a separate table must be consulted. The tally sheets should be totallied for all diameters, species and height classes and divided by the number of acres actually covered to get the average number of trees per acre in each class. If the tally has been made by diameters alone, a secondary study should be carried out on a requisite number of trees in each species to get the average height class for each diameter width in the species. Consult a volume for each species for the volume of a tree represented within each class on the tally sheet. Multiply this volume value, which is the average value for a tree of that class, by the number of trees represented in each class in the tally. Total all values within each species. Total for all species. This will give the stand per acre.

TABLE 10

VOLUME TABLE — WHITE ASH

Sterrett, 1915. Eastern States: Based on 475 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET — SCRIBNER RULE						
	NUMBER OF 16-FOOT LOGS						
	2	2½	3	3½	4	4½	5
8	32	43	51	69	.....	.....	.....
9	37	50	60	80	.....	.....	.....
10	42	58	70	91	.....	.....	.....
11	49	68	80	100	.....	.....	.....
12	57	78	93	120	140	.....	.....
13	66	90	110	130	160	.....	.....
14	77	100	120	150	180	200	230
15	90	120	140	170	200	230	260
16	100	130	160	190	220	260	290
17	120	150	180	210	250	290	330
18	.....	170	200	240	280	320	370
19	.....	190	230	270	320	360	420
20	.....	210	250	300	360	410	470
21	.....	230	280	340	400	460	520
22	.....	260	310	380	450	510	590
23	.....	290	350	420	500	580	660
24	.....	.....	380	460	550	650	740
25	.....	.....	420	510	610	730	830
26	.....	.....	460	570	680	810	920
27	.....	.....	510	630	760	890	1020
28	.....	.....	560	690	840	980	1130
29	.....	.....	.....	760	920	1070	1240
30	.....	.....	.....	830	1010	1170	1360

TABLE 11

VOLUME TABLE — ASPEN

Marston, Frothingham, 1906 Maine: Based on 362 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CUBIC FEET						
	TOTAL HEIGHT CLASS OF THE TREE IN FEET						
	30	40	50	60	70	80	90
6	2.0	2.5	3.0	3.5	4.5	6.0	.....
7	3.5	4.0	4.5	5.5	7.0	8.5	.....
8	5.5	6.0	7.0	8.0	10.0	11.5	13.0
9	7.0	8.0	9.5	11.0	12.5	14.5	16.5
10	9.5	10.5	12.0	14.0	16.0	18.0	20.0
11	.....	13.5	15.0	17.0	19.0	21.5	25.0
12	.....	16.5	18.0	20.5	23.0	26.5	30.0
13	.....	.....	21.5	24.0	27.0	31.5	36.0
14	.....	.....	25.0	28.5	32.0	37.0	43.0
15	.....	.....	28.0	32.0	37.0	43.0	51.0
16	.....	.....	.....	37.0	43.0	50.0	59.0
17	.....	.....	.....	43.0	49.5	57.0	68.0
18	.....	.....	.....	49.5	57.0	66.0	76.0
19	.....	.....	.....	56.0	65.0	75.0	85.0
20	.....	.....	.....	64.0	74.0	84.0	95.0

TABLE 12

VOLUME TABLE — ASPEN

Marston, Frothingham, 1906 Maine: Based on 362 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CORDS*						
	TOTAL HEIGHT CLASS OF THE TREE IN FEET						
	30	40	50	60	70	80	90
6	0.02	0.03	0.04	0.05	0.06	0.07	.....
7	0.04	0.05	0.06	0.07	0.08	0.09	.....
8	0.06	0.07	0.08	0.09	0.10	0.12	0.15
9	0.08	0.09	0.10	0.12	0.14	0.16	0.18
10	0.10	0.12	0.13	0.15	0.18	0.20	0.22
11	.....	0.15	0.17	0.19	0.22	0.24	0.27
12	.....	0.18	0.20	0.23	0.26	0.29	0.33
13	.....	.....	0.24	0.27	0.31	0.35	0.40
14	.....	.....	0.27	0.31	0.36	0.41	0.48
15	.....	.....	0.32	0.36	0.41	0.48	0.57
16	.....	.....	.....	0.41	0.47	0.56	0.66
17	.....	.....	.....	0.47	0.54	0.63	0.75
18	.....	.....	.....	0.54	0.62	0.71	0.84
19	.....	.....	.....	.....	0.71	0.80	0.94
20	.....	.....	.....	.....	0.81	0.91	1.05

* Converted from the original table in cubic feet on the basis of 90 cubic feet (solid) to the cord.

TABLE 13

VOLUME TABLE — BASSWOOD

Frothingham, 1915

U. S. Forest Service Bulletin No. 285 Lake States: Based on 319 trees

D.B.H. ob in inches	VOLUME IN BOARD FEET — SCRIBNER RULE							
	NUMBER OF 16-FOOT LOGS							
	1	1½	2	2½	3	3½	4	4½
8	16	21	30	43	60	....	....	....
9	17	23	36	53	69	....	....	....
10	18	26	44	60	79	100	130	....
11	....	31	53	70	90	110	140	....
12	....	38	63	80	100	130	160	....
13	....	....	75	94	120	150	180	220
14	....	....	89	110	140	170	200	240
15	....	....	100	130	160	190	230	270
16	....	....	120	150	180	220	260	300
17	....	....	....	170	210	250	290	340
18	....	....	....	190	240	280	330	380
19	....	....	....	210	270	320	370	430
20	....	....	....	240	300	360	420	480
21	....	....	....	270	340	400	470	540
22	....	....	....	300	380	450	520	600
23	....	....	....	340	420	500	580	670
24	....	....	....	380	470	560	650	750
25	....	....	....	....	520	620	720	830
26	....	....	....	....	570	680	790	920
27	....	....	....	....	620	750	870	1010
28	....	....	....	....	680	820	960	1100
29	....	....	....	....	740	890	1040	1190
30	....	....	....	....	800	970	1130	1290

TABLE 14

VOLUME TABLE — BEECH

Frothingham, 1915

U. S. Forest Service Bulletin No. 285 Michigan: Based on 285 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET						
	NUMBER OF 16-FOOT LOGS						
	1	1½	2	2½	3	3½	4
10	22	32	47	67	87	110	.....
11	25	36	52	77	100	130	.....
12	29	42	61	91	120	150	170
13	35	50	74	110	140	170	200
14	42	60	92	130	170	200	230
15	50	75	120	160	200	230	270
16	.....	.....	150	190	230	270	310
17	.....	.....	180	220	270	310	360
18	.....	.....	220	260	310	350	410
19	.....	.....	.....	290	350	400	460
20	.....	.....	.....	330	390	450	510
21	.....	.....	.....	370	430	500	570
22	.....	.....	.....	400	470	560	640
23	.....	.....	.....	440	520	610	710
24	.....	.....	.....	490	570	670	780
25	.....	.....	.....	530	620	740	870

TABLE 15

VOLUME TABLE — BEECH

Waha and Cheever, 1903 — New York: Based on 485 trees

MERCHANTABLE VOLUME IN STANDARD RAILROAD TIES

D.B.H. ob inches	Number of standard ties, 7″ x 9″ x 8′	D.B.H. ob inches	Number of standard ties, 7″ x 9″ x 8′
12	1	22	7
13	2	23	8
14	3	24	9
15	3	25	10
16	3	26	11
17	4	27	11
18	4	28	12
19	5	29	13
20	6	30	14
21	7		

TABLE 16

VOLUME TABLE — PAPER BIRCH

Dana, 1907. — Maine-New Hampshire: Based on 445 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CUBIC FEET				
	TOTAL HEIGHT OF TREE IN FEET				
	50	60	70	80	90
6	5.2	5.9	6.7	7.8	....
7	6.8	7.8	9.9	10.4	12.2
8	8.9	10.2	11.5	13.3	15.3
9	11.2	12.8	14.5	16.5	18.8
10	14.0	15.9	18.0	20.4	22.8
11	17.2	19.5	21.8	24.6	27.5
12	20.0	23.4	26.3	29.5	33.0
13	....	28.0	31.5	35.3	39.6
14	....	33.0	37.3	42.1	47.4
15	....	38.9	44.0	49.7	55.8
16	....	....	51.0	57.5	60.0

TABLE 17

VOLUME TABLE — PAPER BIRCH

Maine-New Hampshire: Based on 445 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET*					
	TOTAL HEIGHT OF TREE IN FEET					
	40	50	60	70	80	90
6	18	22	26	30	35	.....
7	24	28	34	40	46	52
8	32	38	45	52	60	68
9	40	48	57	67	76	86
10	50	60	72	85	95	108
11	64	73	88	104	117	132
12	78	88	106	124	141	160
13	.....	106	127	148	169	191
14	.....	126	150	176	201	226
15	.....	.....	177	207	236	266
16	.....	.....	206	242	276	310
17	.....	.....	.....	280	320	360
18	.....	.....	.....	320	366	412

* Converted from the original, Table 16, in cubic feet.

TABLE 18

VOLUME TABLE — YELLOW BIRCH

H. C. Belyea, 1919. St. Lawrence Co., N. Y.: Based on 351 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET — SCRIBNER RULE					
	NUMBER OF 16-FOOT LOGS					
	1	1½	2	2½	3	3½
10	32	43	55	.....	.....	.....
11	36	48	60	72	.....	.....
12	41	53	66	80	.....	.....
13	47	60	75	95	.....	.....
14	54	67	86	106	.....	.....
15	61	75	97	122	145	168
16	68	84	107	140	166	198
17	76	95	123	158	193	229
18	84	108	139	175	217	262
19	93	121	157	200	246	300
20	102	136	177	224	281	345
21	112	150	198	254	317	392
22	123	169	222	285	357	445
23	135	186	245	317	400	496
24	148	206	271	350	441	550
25	162	223	296	385	495	621
26	177	243	324	418	538	678
27	193	264	351	452	590	750
28	210	286	382	500	645	830
29	229	310	420	549	710	920
30	250	336	452	598	775	1050

TABLE 19

VOLUME TABLE — YELLOW BIRCH

Waha and Cheever, 1903 — New York: Based on 941 trees

MERCHANTABLE VOLUME IN STANDARD RAILROAD TIES

D.B.H. ob inches	Number of standard ties, 7″ x 9″ x 8′	D.B.H. ob inches	Number of standard ties, 7″ x 9″ x 8′
12	1	22	6
13	1	23	6
14	2	24	7
15	2	25	7
16	3	26	8
17	3	27	8
18	4	28	9
19	4	29	9
20	5	30	9
21	5		

TABLE 20

VOLUME TABLE — CHESTNUT

Chapman, 1912. — Pike Co., Pa.: Based on 222 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME OF THE TREES IN CUBIC FEET				
	TOTAL HEIGHT CLASS OF THE TREE IN FEET				
	30	40	50	60	70
3	0.8	1.7	....	....	....
4	1.4	2.4	....	....	....
5	2.2	3.1	4.6	....	....
6	3.2	3.8	5.4	....	....
7	....	4.8	6.5	....	....
8	....	6.0	7.7	....	....
9	....	7.6	9.5	12.6	....
10	....	9.6	12.2	15.0	....
11	....	....	15.2	18.4	....
12	....	....	18.6	22.0	....
13	....	....	23.1	26.6	....
14	....	....	27.9	30.8	....
15	....	....	....	35.3	....
16	....	....	....	40.0	....
17	....	....	....	44.7	....
18	....	....	....	50.4	....
19	....	....	....	56.9	....
20	....	....	....	63.4	....

TABLE 21

VOLUME TABLE — CHESTNUT

Pike Co., Pa.: Based on 222 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET*					
	TOTAL HEIGHT CLASS OF THE TREE IN FEET					
	20	30	40	50	60	70
6	10	15	18	26	.....	.....
7	.....	19	24	33	.....	.....
8	.....	25	32	41	57	.....
9	.....	34	42	52	69	.....
10	.....	45	54	70	85	.....
11	.....	.....	70	88	107	.....
12	.....	.....	.....	110	133	155
13	.....	.....	.....	139	160	176
14	.....	.....	.....	168	186	200
15	.....	.....	.....	200	215	230
16	.....	.....	.....	230	246	260
17	.....	.....	.....	.....	277	300
18	.....	.....	.....	.....	314	340
19	.....	.....	.....	.....	356	385
20	.....	.....	.....	.....	400	440

* Converted to board foot values and extended from the original, Table 20, in cubic feet.

TABLE 22

VOLUME TABLE — HICKORY

Boisen, 1910. Eastern States: Based on 365 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CUBIC FEET					
	TOTAL HEIGHT OF THE TREE IN FEET					
	40	50	60	70	80	90
6	1.3	1.8	2.4	3.1	.....	.....
7	1.9	2.5	3.2	4.0	5.1	.....
8	2.6	3.4	4.2	5.3	6.5	8.0
9	3.6	4.6	5.8	7.0	8.4	10.2
10	4.8	6.1	7.4	8.9	10.7	12.5
11	6.3	7.8	9.4	11.3	13.2	15.5
12	7.8	9.5	11.6	13.7	15.9	18.4
13	.....	11.7	14.2	16.7	19.4	22.3
14	.....	.....	17.0	19.7	22.8	26.1
15	.....	.....	19.5	22.6	26.1	29.5
16	.....	.....	.....	26.1	30.0	33.9
17	.....	.....	.....	29.4	33.9	38.2
18	.....	.....	.....	32.8	37.6	42.5

TABLE 23

VOLUME TABLE — HICKORY

Eastern States: Based on 365 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET*					
	TOTAL HEIGHT OF THE TREE IN FEET					
	40	50	60	70	80	90
6	6	9	12	15	.....	.....
7	9	13	16	20	26	.....
8	13	18	22	28	34	42
9	19	25	32	38	46	55
10	27	34	42	50	60	71
11	36	45	54	65	76	90
12	46	56	68	81	94	108
13	.....	70	85	100	116	132
14	.....	.....	103	119	138	158
15	.....	.....	119	138	159	180
16	.....	.....	.....	161	184	208
17	.....	.....	.....	184	208	236
18	.....	.....	.....	206	234	265

* Converted from the original, Table 22, in cubic feet.

TABLE 24

VOLUME TABLE — SUGAR MAPLE

Frothingham, 1915 — Lake States: Based on 278 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET — SCRIBNER RULE						
	NUMBER OF 16-FOOT LOGS						
	1	1½	2	2½	3	3½	4
8	20	25	31	38	.....	.....	.....
9	23	30	40	50	.....	.....	.....
10	28	37	47	62	76	94	.....
11	34	43	59	76	93	110	.....
12	40	50	70	91	110	135	170
13	.....	57	82	110	130	160	190
14	.....	65	95	130	155	190	220
15	.....	73	110	150	180	220	250
16	.....	83	120	170	210	250	290
17	.....	93	140	190	240	280	330
18	.....	100	160	220	270	320	380
19	.....	.....	180	240	300	370	430
20	.....	.....	200	270	340	410	490
21	.....	.....	220	300	380	460	550
22	.....	.....	250	340	420	520	620
23	.....	.....	.....	370	470	580	690
24	.....	.....	.....	410	520	640	770
25	.....	.....	.....	460	570	710	840
26	.....	.....	.....	500	630	780	930

TABLE 25

VOLUME TABLE — SUGAR MAPLE

Waha and Cheever, 1903 New York: Based on 296 trees

MERCHANTABLE VOLUME IN STANDARD RAILROAD TIES

D.B.H. ob inches	Number of standard ties, 7″ x 9″ x 8′	D.B.H. ob inches	Number of standard ties, 7″ x 9″ x 8′
12	2	20	5
13	2	21	6
14	2	22	6
15	3	23	6
16	3	24	7
17	3	25	8
18	4	26	10
19	5		

TABLE 26

VOLUME TABLE — RED, BLACK AND SCARLET OAKS

Peters, 1905. Connecticut and New York: Based on 441 trees

D.B.H. ob in inches	VOLUME IN BOARD FEET*						
	TOTAL HEIGHT CLASS OF THE TREE IN FEET						
	30	40	50	60	70	80	90
6	17	20	24	29	.....	.....	.....
7	.....	29	34	39	45	.....	.....
8	.....	39	46	54	65	.....	.....
9	.....	51	61	74	88	104	.....
10	.....	63	77	93	110	127	.....
11	.....	77	96	115	134	155	.....
12	.....	.....	114	136	166	185	.....
13	.....	.....	134	161	189	218	247
14	.....	.....	156	187	219	252	285
15	.....	.....	.....	216	254	294	335
16	.....	.....	.....	249	292	338	385
17	.....	.....	.....	285	335	386	438
18	.....	.....	.....	325	380	436	493
19	.....	.....	.....	369	429	491	555
20	.....	.....	.....	417	481	547	614

* Converted to board foot values from the original table in cubic feet.

TABLE 27

VOLUME TABLE — WHITE AND CHESTNUT OAKS

Peters, 1905. Connecticut and New York: Based on 293 trees

D.B.H. ob in inches	VOLUME IN BOARD FEET*					
	TOTAL HEIGHT CLASS OF THE TREE IN FEET					
	40	50	60	70	80	90
6	20	24	29	.....	.....	.....
7	29	34	39	45	.....	.....
8	39	46	55	65	.....	.....
9	51	61	73	88	104	.....
10	63	77	93	110	131	.....
11	77	96	115	135	156	.....
12	93	114	136	161	185	.....
13	.....	134	161	189	217	.....
14	.....	157	188	218	256	.....
15	.....	.....	217	255	292	.....
16	.....	.....	249	294	331	381
17	.....	.....	285	327	374	423
18	.....	.....	325	371	419	469
19	.....	.....	365	417	465	525
20	.....	.....	415	463	520	591

* Converted to board foot values from the original table in cubic feet.

TABLE 28

CORDWOOD VOLUME TABLE FOR SECOND GROWTH WHITE OAK

Peters, 1905. New York: Based on 349 trees

D.B.H. ob in inches	CORDWOOD VOLUME IN CUBIC FEET*				
	TOTAL HEIGHT CLASS OF THE TREE IN FEET				
	20	30	40	50	60
2	0.2	0.5	....	....	....
3	0.5	0.8	1.1	....	....
4	0.9	1.4	1.8	....	....
5	....	2.3	2.7	3.2	....
6	....	3.4	4.0	4.8	5.7
7	....	4.8	5.7	6.6	7.9
8	....	....	7.7	9.0	10.6
9	....	....	....	11.8	13.6
10	....	....	....	15.3	17.3
11	....	....	....	19.6	22.6
12	....	....	....	24.6	28.0
13	....	....	....	....	32.2
14	....	....	....	....	37.2
15	....	....	....	....	42.0

* These volumes include all of the tree that can be utilized for cordwood down to a diameter of one inch. A cord made up of mixed diameters, is considered to contain 80 cubic feet of solid wood, and the values from this table can be directly converted to cords by dividing by 80.

TABLE 29

VOLUME TABLE — BALSAM FIR

Zon, 1914.

U. S. Forest Service Bulletin No. 55. New York: Based on 947 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CUBIC FEET				
	HEIGHT OF TREE IN FEET				
	40	50	60	70	80
6	3.5	4.0	....	....	....
7	4.5	5.1	5.9	....	....
8	5.9	6.8	8.0	9.1	....
9	7.6	8.9	10.4	11.9	....
10	....	11.2	13.0	14.8	16.6
11	....	13.6	15.6	17.6	19.8
12	....	....	18.3	20.9	23.6
13	....	....	21.1	24.5	27.7
14	....	....	....	28.4	32.2
15	....	....	....	32.9	37.5
16	....	....	....	37.8	43.2

TABLE 30

VOLUME TABLE — BALSAM FIR

Zon, 1914 (curved). New York: Based on 947 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET — HOLLAND RULE*				
	HEIGHT OF TREE IN FEET				
	40	50	60	70	80
6	10	12	....	....	....
7	13	15	17	....	....
8	19	22	26	29	....
9	25	29	34	39	....
10	....	37	43	49	55
11	....	46	52	60	64
12	....	....	61	71	81
13	....	....	71	82	94
14	....	....	....	99	115
15	....	....	....	120	131
16	....	....	....	132	151

* Table obtained by converting cubic foot volumes to board feet, by use of converting factors offered by Zon, U. S. Forest Service Bulletin No. 55, page 55.

TABLE 31

NUMBER OF TREES PER CORD — BALSAM FIR

Zon, 1914. Maine and New York:
U. S. Forest Service Bulletin No. 55. Based on 2171 trees

D.B.H. ob in inches	NUMBER OF TREES PER CORD							
	HEIGHT OF TREE IN FEET							
	20	30	40	50	60	70	80	90
3	200	125	.....	.....	.....	.....	.....	.....
4	111.1	62.5	45.5	.....	.....	.....	.....	.....
5	62.5	41.7	30.3	23.8	.....	.....	.....	.....
6	.....	29.4	22.2	17.5	14.7	.....	.....	.....
7	.....	22.2	16.7	13.3	11.2	9.5	.....	.....
8	.....	.....	12.8	10.4	8.8	7.3	6.0	.....
9	.....	.....	10.1	8.4	7.0	5.8	4.9	.....
10	.....	.....	8.3	6.4	5.8	4.9	4.2	.....
11	.....	.....	6.8	5.6	4.9	4.1	3.6	.....
12	.....	.....	.....	4.7	4.1	3.6	3.1	.....
13	.....	.....	.....	.....	3.5	3.1	2.7	.....
14	.....	.....	.....	.....	.....	2.7	2.4	.....
15	.....	.....	.....	.....	.....	2.4	2.2	.....

TABLE 32

VOLUME TABLE — HEMLOCK

Frothingham, 1915.
U. S. Forest Service Bulletin No. 152. Lake States: Based on 534 trees

D.B.H. ob in inches	VOLUME IN BOARD FEET — SCRIBNER RULE						
	HEIGHT OF TREE IN FEET						
	40	50	60	70	80	90	100
8	7	13	20	25	30	.....	.....
9	14	22	29	35	40	.....	.....
10	22	32	40	47	52	.....	.....
11	29	41	52	60	67	75	.....
12	37	53	64	76	84	93	.....
13	46	65	78	94	100	110	.....
14	56	77	95	110	130	140	.....
15	65	90	110	130	150	160	.....
16	76	110	130	160	180	190	.....
17	.....	120	150	180	210	220	240
18	.....	140	180	210	240	260	280
19	.....	160	200	240	280	300	320
20	.....	180	230	280	310	340	360
21	.....	200	260	310	350	380	410
22	.....	220	290	350	390	430	470
23	.....	.....	330	380	440	480	520
24	.....	.....	360	420	490	540	580
25	.....	.....	390	460	530	600	650
26	.....	.....	430	510	580	660	720
27	.....	.....	470	550	640	720	790
28	.....	.....	500	590	690	780	870
29	.....	.....	540	640	750	850	940
30	.....	.....	570	680	800	920	1030

TABLE 33

VOLUME TABLE — HEMLOCK

H. C. Belyea, 1919. St. Lawrence Co., New York: Based on 950 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CUBIC FEET						
	HEIGHT OF TREE IN FEET						
	40	50	60	70	80	90	100
6	5.1	6.5	.....	.....	.....	.....	.....
7	6.3	8.2	.....	.....	.....	.....	.....
8	8.4	10.0	11.0	.....	.....	.....	.....
9	10.6	12.7	15.3	.....	.....	.....	.....
10	12.7	15.2	18.2	21.3	.....	.....	.....
11	14.4	17.9	21.6	25.6	30.3	.....	.....
12	17.5	21.3	25.3	29.5	34.1	.....	.....
13	21.1	25.3	29.6	34.4	39.6	.....	.....
14	.....	29.3	34.4	39.8	45.5	52.0	.....
15	.....	33.1	38.8	44.6	51.2	58.3	.....
16	.....	37.2	43.2	49.9	57.4	65.3	73.5
17	.....	41.5	49.0	56.2	64.0	72.3	80.9
18	.....	45.9	54.7	63.2	72.3	82.5	93.5
19	.....	.....	60.4	69.9	80.3	93.5	107.0
20	.....	.....	66.1	76.4	89.3	105.0	121.0
21	.....	.....	71.8	83.4	99.3	116.5	135.5
22	.....	.....	.....	90.9	110.3	130.0	150.4
23	.....	.....	.....	98.9	122.3	144.2	167.7
24	.....	.....	.....	107.9	134.5	159.1	184.5
25	.....	.....	.....	117.9	147.3	175.2	201.5
26	.....	.....	.....	130.9	161.3	194.5	218.6
27	.....	.....	.....	.....	172.5	210.3	235.5
28	.....	.....	.....	.....	179.8	228.4	254.4
29	.....	.....	.....	.....	195.3	246.3	274.2
30	.....	.....	.....	.....	211.3	264.5	294.5

TABLE 34

VOLUME TABLE — HEMLOCK BARK

Frothingham, 1915. Vermont, Appalachian Region:
U. S. Forest Service Bulletin No. 152. Based on 682 trees

D.B.H. ob in inches	VOLUME OF BARK IN CORDS	
	Volume of bark	Volume of bark per 1000 b. f.— Scribner
10	0.06	3.5
11	0.07	2.9
12	0.08	2.8
13	0.09	2.3
14	0.10	1.9
15	0.12	1.6
16	0.14	1.3
17	0.16	1.2
18	0.18	1.1
19	0.20	1.0
20	0.22	0.9
21	0.25	0.8
22	0.28	0.8
23	0.31	0.7
24	0.34	0.7
25	0.37	0.6
26	0.40	0.6
27	0.42	0.5
28	0.44	0.5
29	0.47	0.5
30	0.50	0.4

TABLE 35

VOLUME TABLE — RED SPRUCE

H. C. Belyea, 1918. St. Lawrence Co., New York: Based on 1260 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CUBIC FEET					
	TOTAL HEIGHT CLASS OF THE TREE IN FEET					
	50	60	70	80	90	100
8	6.5	8.0	11.0	14.0	.....	.....
9	8.0	11.0	14.0	17.5	.....	.....
10	11.0	14.0	17.5	22.5	.....	.....
11	14.5	18.0	22.0	28.0	.....	.....
12	18.0	22.0	27.0	33.5	.....	.....
13	.....	26.0	31.5	38.5	.....	.....
14	.....	29.5	36.0	43.5	.....	.....
15	.....	32.5	40.0	48.5	58.0	.....
16	.....	36.0	44.0	53.5	63.0	.....
17	.....	39.0	48.0	58.5	68.5	.....
18	.....	.....	52.0	64.0	73.0	.....
19	.....	.....	56.0	69.0	78.0	90.0
20	.....	.....	60.0	74.0	83.0	96.0
21	.....	.....	.....	79.0	89.0	102.5
22	.....	.....	.....	84.5	95.0	109.0
23	.....	.....	.....	90.0	102.0	116.0
24	.....	.....	.....	97.0	109.0	123.5
25	.....	.....	.....	103.0	116.0	132.0

TABLE 36

VOLUME TABLE — RED SPRUCE

H. C. Belyea, 1918. St. Lawrence Co., New York: Based on 1260 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN CORDS*					
	TOTAL HEIGHT CLASS OF THE TREE IN FEET					
	50	60	70	80	90	100
8	0.03	0.05	0.07	0.13	.....	.....
9	0.08	0.11	0.13	0.19	.....	.....
10	0.12	0.16	0.19	0.25	.....	.....
11	0.16	0.20	0.25	0.31	.....	.....
12	0.20	0.25	0.30	0.37	.....	.....
13	.....	0.29	0.35	0.43	.....	.....
14	.....	0.33	0.40	0.49	.....	.....
15	.....	0.36	0.45	0.54	0.64	.....
16	.....	0.40	0.49	0.59	0.70	.....
17	.....	0.43	0.53	0.65	0.76	.....
18	.....	.....	0.58	0.71	0.81	.....
19	.....	.....	0.62	0.77	0.86	1.00
20	.....	.....	0.67	0.82	0.92	1.07
21	.....	.....	.....	0.88	0.99	1.14
22	.....	.....	.....	0.95	1.05	1.21
23	.....	.....	.....	1.00	1.13	1.29
24	.....	.....	.....	1.08	1.21	1.37
25	.....	.....	.....	1.14	1.28	1.47

* Converted from original table in cubic feet on the basis that 90 cubic feet (solid) equals one cord.

TABLE 37

VOLUME TABLE — RED SPRUCE

Murphy, 1917. New York: Based on 1507 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET — SCRIBNER RULE					
	TOTAL HEIGHT CLASS OF THE TREE IN FEET					
	50	60	70	80	90	100
8	34	41	48	.....	.....	.....
9	43	53	67	75	.....	.....
10	55	67	78	90	100	.....
11	68	82	96	110	130	140
12	82	97	110	130	150	170
13	97	120	130	160	180	200
14	110	135	160	180	200	230
15	120	150	180	210	230	260
16	140	170	200	240	270	300
17	160	190	230	270	300	340
18	180	220	260	300	340	380
19	.....	250	290	340	380	430
20	.....	270	320	380	430	480
21	.....	300	360	420	480	540
22	.....	320	400	470	540	600
23	.....	.....	440	530	600	670
24	.....	.....	490	580	670	750
25	.....	.....	540	640	740	840

TABLE 38

VOLUME TABLE — RED SPRUCE

Murphy, 1917. New York: Based on 1507 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET — SCRIBNER RULE								
	NUMBER OF 16-FOOT LOGS								
	1	1½	2	2½	3	3½	4	4½	5
8	19	32	43	56	....	....	....	....	.....
9	24	36	49	64	73	....	....	....	.....
10	30	41	56	72	85	100	....	....	.....
11	36	47	65	81	98	120	....	....	.....
12	42	54	74	91	110	130	160	....	.....
13	....	60	84	100	130	150	180	....	.....
14	....	67	95	120	140	170	200	230	.....
15	....	75	110	130	160	190	220	260	.....
16	....	....	120	150	180	210	250	290	.....
17	....	....	130	160	200	230	270	320	.....
18	....	....	140	180	220	260	300	350	410
19	....	....	....	200	240	290	340	390	450
20	....	....	....	210	260	320	370	430	500
21	....	....	....	....	290	350	410	470	550
22	....	....	....	....	320	380	450	520	600
23	....	....	....	....	350	410	490	570	660
24	....	....	....	....	380	450	530	620	730
25	....	....	....	....	410	480	580	680	800

TABLE 39

VOLUME TABLE — RED SPRUCE

Murphy, 1917. New York: Based on 1507 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN STANDARDS — DIMICK'S RULE*					
	TOTAL HEIGHT CLASS OF THE TREE IN FEET					
	50	60	70	80	90	100
8	0.20	0.27	0.32	.....	.....	.....
9	0.20	0.36	0.41	.....	.....	.....
10	0.37	0.44	0.50	0.56	.....	.....
11	0.44	0.54	0.62	0.70	.....	.....
12	0.52	0.64	0.74	0.83	0.92	.....
13	0.60	0.74	0.86	0.97	1.07	.....
14	0.69	0.84	0.99	1.12	1.24	1.36
15	0.77	0.94	1.12	1.28	1.42	1.55
16	0.86	1.06	1.26	1.44	1.61	1.76
17	0.95	1.18	1.40	1.62	1.81	1.99
18	1.05	1.31	1.57	1.80	2.03	2.23
19	.....	1.43	1.73	2.00	2.26	2.49
20	.....	1.55	1.90	2.22	2.51	2.78
21	.....	1.69	2.08	2.44	2.77	3.08
22	.....	1.83	2.27	2.67	3.04	3.39
23	.....	.....	2.47	2.90	2.32	3.72
24	.....	.....	2.66	3.14	3.61	4.06
25	.....	.....	2.85	3.39	3.92	4.42

* A Dimick Standard is equal to the volume of a log thirteen feet long and nineteen inches in diameter inside the bark at the small end.

TABLE 40

VOLUME TABLE — RED SPRUCE

Murphy, 1917. New York: Based on 1507 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN STANDARDS — DIMICK'S RULE*								
	NUMBER OF 16-FOOT LOGS								
	1	1½	2	2½	3	3½	4	4½	5
8	0.14	0.22	0.29	0.37	....	....	....	....	.....
9	0.16	0.24	0.33	0.42	0.47	....	....	....	.....
10	0.19	0.28	0.38	0.47	0.55	0.66	....	....	.....
11	0.22	0.32	0.43	0.53	0.63	0.75	....	....	.....
12	0.26	0.36	0.48	0.60	0.72	0.85	0.98	....	.....
13	....	0.41	0.53	0.66	0.80	0.95	1.10	....	.....
14	....	0.46	0.59	0.73	0.89	1.06	1.23	1.41	.....
15	....	0.51	0.65	0.81	0.98	1.17	1.36	1.56	.....
16	....	....	0.71	0.89	1.08	1.29	1.50	1.71	.....
17	....	....	0.77	0.97	1.18	1.41	1.64	1.81	.....
18	....	....	0.83	1.05	1.29	1.54	1.80	2.07	2.39
19	....	....	....	1.14	1.40	1.68	1.96	2.17	2.59
20	....	....	....	1.22	1.51	1.82	2.14	2.48	2.81
21	....	....	....	....	1.64	1.98	2.33	2.69	3.05
22	....	....	....	....	1.77	2.14	2.53	2.92	3.31
23	....	....	....	....	1.92	2.32	2.74	3.16	3.60
24	....	....	....	....	2.07	2.51	2.96	3.41	3.90
25	....	....	....	....	2.22	2.70	3.19	3.68	4.20

* A Dimick Standard is equal to the volume of a log thirteen feet long and nineteen inches in diameter inside the bark at the small end of the log.

TABLE 41

VOLUME TABLE — RED PINE

Woolsey, 1905. Minnesota: Based on 964 trees

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET — SCRIBNER RULE					
	TOTAL HEIGHT CLASS OF THE TREE IN FEET					
	50	60	70	80	90	100
10	55	70	85	105	.....	.....
11	62	82	102	126	147	.....
12	76	98	122	150	177	.....
13	90	112	144	178	210	.....
14	106	132	168	208	246	.....
15	123	153	193	240	284	.....
16	.....	176	220	275	323	383
17	.....	202	250	311	370	435
18	.....	229	282	349	417	490
19	.....	.....	317	390	468	551
20	.....	.....	355	433	523	616
21	.....	.....	396	480	582	685
22	.....	.....	.....	530	646	755
23	.....	.....	.....	584	715	830
24	.....	.....	.....	.....	790	905
25	.....	.....	.....	.....	867	986
26	.....	.....	.....	.....	951	1075
27	.....	.....	.....	.....	1041	1166

TABLE 42

VOLUME TABLE — VIRGIN GROWTH WHITE PINE

New York Conservation Commission. New York State

D.B.H. ob in inches	MERCHANTABLE VOLUME IN BOARD FEET							
	TOTAL HEIGHT OF TREES IN FEET							
	40	45	50	55	60	65	70	75
8	20	23	27	30	34	40	46	49
9	28	31	35	39	43	50	58	63
10	34	39	44	49	54	62	71	77
11	41	47	54	61	68	78	88	94
12	50	58	66	74	82	91	100	110
13	58	68	79	88	98	109	120	130
14	66	79	93	106	120	130	140	155
15	74	92	110	125	140	150	160	175
16	83	106	130	145	160	175	190	205
17	93	121	150	165	180	195	210	230
18	100	130	166	180	200	220	240	260
19	.....	.....	180	205	230	250	270	290
20	.....	.....	210	235	260	280	300	325
21	.....	.....	.....	.....	290	310	330	360
22	.....	.....	.....	.....	320	340	360	395
23	.....	.....	.....	.....	350	375	400	435
24	.....	.....	.....	.....	380	405	430	470
25	.....	.....	.....	.....	.....	.....	470	510
26	.....	.....	.....	.....	.....	.....	510	556
27	.....	.....	.....	.....	.....	.....	550	600
28	.....	.....	.....	.....	.....	.....	590	645
29	.....	.....	.....	.....	.....	.....	630	690
30	.....	.....	.....	.....	.....	.....	670	740
31	.....	.....	.....	.....	.....	.....	.....	.....
32	.....	.....	.....	.....	.....	.....	.....	.....
33	.....	.....	.....	.....	.....	.....	.....	.....
34	.....	.....	.....	.....	.....	.....	.....	.....
35	.....	.....	.....	.....	.....	.....	.....	.....
36	.....	.....	.....	.....	.....	.....	.....	.....
37	.....	.....	.....	.....	.....	.....	.....	.....
38	.....	.....	.....	.....	.....	.....	.....	.....
39	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....
41	.....	.....	.....	.....	.....	.....	.....	.....
42	.....	.....	.....	.....	.....	.....	.....	.....

TABLE 42 — (*Continued*)

D.B.H. ob in inches	Merchantable Volume in Board Feet						
	Total height of trees in feet						
	80	85	90	95	100	105	110
8	53	56	60	.....	.....	.....	.....
9	68	72	77	.....	.....	.....	.....
10	83	89	96	103	110	.....	.....
11	100	110	120	125	130	.....	.....
12	120	130	140	150	160	170	180
13	140	155	170	180	190	200	210
14	170	185	200	210	220	230	240
15	190	210	230	240	250	265	280
16	220	240	260	270	280	300	320
17	250	270	290	305	320	340	360
18	280	300	320	340	360	380	400
19	310	335	360	380	400	425	450
20	350	375	400	425	450	475	500
21	390	415	440	465	490	520	550
22	430	445	480	510	540	575	610
23	470	500	530	565	600	635	670
24	510	545	580	620	660	700	740
25	550	595	640	680	720	760	800
26	600	645	690	735	780	830	880
27	650	700	750	800	850	900	950
28	700	755	810	865	920	975	1030
29	750	810	870	930	990	1055	1120
30	810	875	940	1005	1070	1135	1200
31	870	940	1010	1080	1150	1220	1290
32	930	990	1090	1165	1240	1315	1390
33	1000	1085	1170	1250	1330	1410	1490
34	1070	1165	1260	1340	1420	1505	1590
35	1140	1245	1350	1435	1520	1610	1700
36	1220	1330	1440	1530	1620	1720	1820
37	.....	.....	1530	1630	1730	1830	1930
38	.....	.....	1630	1730	1830	1940	2030
39	.....	.....	1730	1835	1940	2055	2170
40	.....	.....	1830	1940	2050	2170	2290
41	.....	.....	1920	2040	2160	2290	2420
42	.....	.....	2020	2150	2280	2415	2550

TABLE 43

CONVERTING FACTORS FOR STANDING TREES*

Cubic Measure to Board Measure†

(Values curved)

D.B.H. ob in inches	One cubic foot is equivalent to:	D.B.H. ob in inches	One cubic foot is equivalent to:
6.....	4.50 board feet	17.....	6.20 board feet
7.....	5.00 board feet	18.....	6.25 board feet
8.....	5.25 board feet	19.....	6.30 board feet
9.....	5.50 board feet	20.....	6.35 board feet
10.....	5.60 board feet	21.....	6.40 board feet
11.....	5.70 board feet	25.....	6.45 board feet
12.....	5.80 board feet	26.....	6.50 board feet
13.....	5.90 board feet	27.....	6.55 board feet
14.....	6.00 board feet	28.....	6.60 board feet
15.....	6.10 board feet	29.....	6.65 board feet
16.....	6.15 board feet	30.....	6.75 board feet

* Frothingham, U. S. Dept. Agriculture Bulletin 152.

† These values were used in these tables converting from cubic feet to board feet.

LIST OF THE PRINCIPAL USES OF NEW YORK SPECIES ARRANGED ALPHABETICALLY

WOOD USED BY SPECIES

APPLEWOOD

Canes
Handles
Planes
Rules
Saw handles
Umbrella handles
Vehicles
Whips
Tobacco pipes

ARBORVITAE (Northern White Cedar)

Boat bottoms
Boat decking
Dairymen's supplies
Ice cream freezers
Interior finish
Roof tanks
Row boats
Shiplap
Siding
Signal devices
Silos
Tanks
Yachts

ASH

Aeroplanes
Axles
Baseball bats
Baskets
Billiard rails
Boats
Bolsters
Boxes
Bread slicing machines
Brick moulds
Broom handles
Butter packages
Butter tubs
Cabinets
Car construction
Casing
Chairs
Cheese boxes
Crates
Cultivators
Desks
Drafting tables
Fence
Finish
Fixtures (store, office)
Flooring
Fork handles
Furniture
Hames
Handles (toy shovel)
Hayracks
Hoe handles
Hoops
Ice boxes
Keyboards
Ladders (rounds)
Machinery (frames)
Machinery (rods)
Mouldings
Neck yokes
Novelties
Organs (frames)
Panels
Piano tops
Pickets
Pick handles
Plow beams
Plow handles
Plugs (for paper)
Poles (vehicles)
Porch swings
Pump rods
Refrigerators
Rings
Rollers (farm machinery)
Sash
Seeder thills
Ships
Siding
Signaling devices
Single trees
Sleds (hand)
Snow shovel handles
Sofas
Souvenirs
Tables
Tackleblock shells
Threshers

ASH — (*Continued*)

Toilet tanks
Toilet seats
Tongues
Trunk slats
Trunk strips
Turnery
Vestibules (cars)
Wagon poles
Wagon (coasters)
Wash trays (frames)
Wash tubs (frames)
Whiffletrees
Window frames

ASPEN

Boxes
Cheese boxes (heading)
Crates
Excelsior
Packing cases
Sheathing
Pulp

BALSAM FIR

Boxes
Cheese boxes (heads)
Crates
Dairy supplies
Doors
Millwork
Sash
Trim
Wood pulp

BASSWOOD

Agricultural implements
Automobiles (parts)
Bank fixtures
Baskets
Beehives
Berry baskets
Billiard table beds
Boats
Boxes
Bread boards
Brooms
Brushes
Business wagon bodies
Butter ladles
Cameras
Candy buckets
Cars
Casing
Caskets
Ceiling
Chairs
Checkers
Cheese box heading
Children's blackboards
Children's sled tops
Cigar boxes
Clocks
Clothes baskets
Clothes pins
Corn planters
Crates
Curtain stretchers
Doubletrees
Dowels
Drawer bottoms
Drills
Dumbwaiters
Elevators
Engraving boards
Excelsior
Feeders
Filing cabinets
Flooring
Furniture
Go-carts
Graders (peach)
Grain hoppers
Grass seeders
Guitars
Hand sled tops
Hayracks
Hobby horses
Incubators
Indian clubs
Ironing boards
Kitchen cabinets
Kitchen tables
Lard tubs
Lawn furniture
Mandolins
Medicine cases
Moulding
Music cabinets
Novelties
Packing boxes
Pails
Panels
Pastry boards
Patterns
Pencils

BASSWOOD — (*Continued*)

Pianos
Piano players
Picture frames
Printers' cabinets
Refrigerators
Rulers
Scientific instruments
Seed cabinets
Shoe trees
Shoe lasts
Shop patterns
Show cases
Shredders
Siding
Silos
Singletrees
Skids
Sleeve boards
Sleigh bodies
Spools
Stackers
Stanchions
Store fixtures
Threshing machines
Tool boxes
Toys
Trays (egg)
Trunks
Tubs
Turnery
Velocipede seats
Wagons
Wagon boxes
Wardrobes
Washboards
Washing machines
Well buckets
Wheelbarrows
Window frames
Woodenware
Yardsticks

BEECH

Agricultural implements
Auto-seat frames
Bobbins
Boxes
Brick molds
Broom handles
Brushes
Built-up panels
Burther blocks
Butter dishes
Butter tubs
Cable reels
Cars
Chairs
Chair bottoms
Chair rods
Cheese boxes
Clocks
Clothes pins
Coat hangers
Coops
Crating
Dowels
Drafting tables
Electrotype plates
Farm machinery
Filing cabinets
Fixtures
Furniture
Grain doors
Hames
Handles
Hand sleds
Ironing boards
Ladders
Lawn swings
Musical instruments
Novelties
Pails
Panels
Pianos
Pipe organs
Printers' cabinets
Pulleys
Pump handles
Pump buckets
Refrigerators
Rope reels
Sash
Sectional bookcases
Show cases
Skates
Sounding boards
Stanchions
Stepladders
Tables
Tie plugs
Trunks
Tubs
Wardrobes
Washing machines
Washboards
Weighing machines
Wheelbarrows
Window screens
Woodenware

BIRCH

Agricultural implements
Baskets
Boat finish
Bobbins
Bookcases
Boxes
Broom handles
Broom heads
Brush backs
Built-up panels
Buffets
Butter boxes
Butter molds
Cabinets
Cameras
Canes
Car finish (vestibules)
Carvings
Casing
Ceiling
Chair rods
Cheese boxes (hoops)
Clocks (turnery parts)
Couch frames
Crating
Desks
Dowels
Dumbwaiter cars
Electrotype bases
Fixtures (exterior parts)
Flooring
Furniture
Games
Harvesters
House trim (veneral)
Interior finish
Kodaks
Lawn mowers
Mantels
Mirror backs
Moulding
Office fixtures
Panels
Paper plugs
Parlor furniture
Partitions
Peavey handles
Picture frames
Plumbers' woodwork
Pulleys
Refrigerators
Sash pins
Screen frames
Settees
Shoe pegs
Shoe trees
Show cases
Sofas
Spool heads
Swings
Store fixtures
Umbrella handles
Tables
Tackleblock shells
Thresher parts
Toys
Tubs
Wall fixtures
Woodenware

BLACK CHERRY

Baskets
Beds
Boat finish
Bookcases
Brushes
Bushel crates
Butter dishes
Cabinets
Camera boxes
Card trays
Cars (finish)
Casing
Caskets
Chairs (posts, rounds)
Clock cases
Coffins
Collar trays
Counters
Desks
Doors
Dowels
Dressers
Flasks
Flooring
Electrotype blocks
Engraving blocks
Glove stretchers
Handle (brush)
Interior finish
Kodaks
Last blocks
Level blocks
Level sticks
Library furniture
Machine boxes
Moulding
Musical instruments
Office fixtures

BLACK CHERRY — (*Continued*)

Panels
Partitions
Passenger cars
Patterns
Piano actions
Piano cases
Piano players
Piano rails
Pipe organ (cases, actions)
Road machines (cabs, boxes)
Sash
School furniture
Settees
Shoe lasts
Siding
Spindle stock
Spoons
Store fixtures
Swings
Switchboards
Tables
Table drawers
Table legs
Trim
Woodenware

BLACK WALNUT

Air-gun stock
Benches
Billiard cues
Bookcases
Brush backs
Bureaus
Cabinet work
Canes
Card tables
Carpet sweepers
Case work
Caskets
Chairs
Chair legs
China closets
Chiffoniers
Clock cases
Coffins
Couches (legs)
Desks
Doors
Electrical appliances (bases)
Embalming boards
Fixtures (exterior parts)
Fixtures, office
Fixtures, store
Furniture
Gunstocks
Inlaid work
Interior finish
Machine boxes
Moulding
Novelties
Organ cases
Parquetry flooring
Pianos
Piano actions
Piano benches
Piano cases
Piano players
Picture frames
Pipe organs
Sideboards
Side tables
Stools
Tool boxes
Umbrella handles
Vehicles
Woodenware

ELM

Agricultural implements
Banana baskets
Baskets (bottoms, covers)
Boxes
Bushel crates
Chairs
Cheese boxes (heads, hoops)
Cigar boxes
Cradle bows
Crating (posts, corners)
Couch frames
Feed tables
Fixtures
Fruit cases (handles, hoops)
Furniture (frames, drawer bottoms, ends)
Grain drills
Grape trays
Handles
Harvesters
Hayracks
Instruments, musical
Laundry appliances
Machine construction
Mowers (poles)
Planing mill products
Reapers (poles)
Refrigators
Rockers
Sash
Ships
Sporting goods

ELM — (*Continued*)

Toys
Trunks (slats)
Tubs
Vehicle poles
Whiffletrees
Woodenware

HEMLOCK

Agricultural implements
Baskets
Blinds
Boxes
Cars
Construction
Crates
Dairymen's supplies
Doors
Fencing (pickets)
Flasks
Flooring
Furniture
Gates (picket)
Instruments, musical
Machines
Patterns
Sash
Ships
Sporting goods
Vehicles
Wood pulp

HICKORY

Agricultural implements
Automobile wheels
Baskets
Boats
Buggy shafts
Buggy spokes
Canes
Car construction (grab handles)
Chairs (rounds)
Doubletrees
Eveners
Gates (pickets)
Handles
Instruments (tripods)
Ladders
Mallets
Machines
Neckyokes
Printing
Refrigerators
Rounds
Shoe shanks
Singletrees
Spokes
Sucker rods
Trunks
Vehicles
Wagon tongues
Woodenware

RED OAK

Agricultural implements
Boats
Boxes
Car construction
Caskets
Coffins
Clocks (cases)
Crates
Elevators
Interior finish
Fencing (pickets)
Fixtures
Flasks
Flooring
Furniture
Gates
Moulding
Musical instruments
Laundry appliances
Machine construction
Patterns
Picture frames
Plumbers' woodwork
Pumps (platforms)
Refrigerators
Sash
Ships
Signs
Scientific instruments
Vehicles
Woodenware

SASSAFRAS

Novelties
Rustic mementoes
Souvenirs
Woodenware

SPRUCE

Agricultural implements
Aeroplanes
Ballup sleepers
Boats
Boat oars
Bowling alleys
Boxes
Bungs
Cable reels and spools
Cameras
Car sheathing
Crates
Doors
Elevator platforms
Farm machinery
Fiber board
Fixtures, backing
Fixtures, linings
Fixtures, office
Fixtures, store
Flag poles
Flooring
Furniture (hidden parts)
Guitars
Hay presses
Ice boxes
Keyboards
Kodaks
Ladder sides
Mandolins
Match cases
Mouldings
Moulding flasks
Musical instruments
Novelties
Organ pipes
Patterns
Piano backs
Piano benches
Piano cases
Piano ribs
Piano sounding boards
Pipe organs
Player actions
Refrigerators (inside partitions)
Scaffolding
Ships
Shiplap
Silos
Skids
Spars
Tanks
Vehicles
Woodenware
Wood pulp

SUGAR (Hard) MAPLE

Agricultural implements
Balls
Baseball bats
Baskets
Bedroom furniture
Billiard cues
Billiard tables
Blueprint frames
Boat finish
Bobbins
Bobsleds
Bowling alleys
Boxes
Brewers' chips
Broom handles
Brush backs
Brush handles
Butcher blocks
Butter ladles
Butter moulds
Cameras
Canes
Car finish
Car flooring
Carpet sweepers
Castor rollers
Ceiling
Chair bottoms
Chair rods
Checkers
Children's wagons
Clothespins
Coat hangers
Corn planters
Corn sheliers
Cot frames
Croquet balls
Croquet mallets
Cultivator handles
Curtain poles
Desks
Dishes
Doors
Dowels
Dominoes
Drill frames
Dumbwaiters
Electrotype blocks
Elevators
Ensilage cutters
Factory trucks
Feeders

SUGAR (Hard) MAPLE — (*Continued*)

Fixtures
Flasks
Folding camp chairs
Flooring
Furniture
Games
Go-carts
Grain drills
Grain separators
Grass seeder frames
Guitars
Hames
Handles
Hay presses
Indian clubs
Interior finish
Kitchen cabinets
Kodaks
Ladders
Lasts
Lawn mowers
Mallets
Mangle rollers
Map rollers
Medicine cabinets
Merry-go-rounds
Moulding
Musical instruments
Novelties
Office fixtures
Organs
Paddles (boat)
Parasol handles
Partitions
Parquetry flooring
Patterns
Pianos
Piano bridges
Piano players
Plow beams
Plumbers' woodwork
Porch swings
Potato mashers
Pulleys
Pumps
Pump buckets
Racks
Refrigerators
Road rollers
Rules
Sash
Separators
Shade rollers
Shoe forms
Show cases
Signs
Skids
Sleighs
Spool barrels
Spoons
Steering wheels
Tanks
Tanning drums
Talking machines
Tenpins
Threshers
Toys
Towel racks
Type cabinets
Umbrella handles
Vehicles
Wagons
Washboards
Washing machines
Wash tray covers
Wheelbarrows
Woodenware
Wood type
Yardsticks

SYCAMORE

Boxes
Crates
Desks (backs)
Drawers (backs, sides)
Flooring
Furniture
Planing mill products
Siding
Trim

TAMARACK

Boat floors
Boat stringers
Boxes
Ceiling
Crates
Finish
Flooring
Millwork
Moulding
Planing mill products
Ships
Siding
Trim

WILLOW

Baskets
Berry boxes
Boat scoops
Fruit crates
Packing cases
Vegetable crates

WHITE OAK

Aeroplanes
Agricultural implements
Athletic goods
Boxes
Car construction
Caskets
Coffins
Clocks
Crates
Elevators
Interior finish
Fencing (pickets)
Fixtures
Flasks
Flooring
Furniture
Gates
Handles
Harvesters
Moulding
Musical instruments
Laundry appliances
Machine construction
Patterns
Picture frames
Plow beams
Plow handles
Plumbers' woodwork
Pumps (platforms)
Refrigerators
Rollers (land)
Sash
Ships
Signs
Spokes
Scientific instruments
Threshing machines
Vehicles
Woodenware

WHITE PINE

Agricultural implements
Automobile bodies
Backing (pictures)
Blinds
Boat flooring
Boxes
Buckets
Burial boxes
Ceiling
Clocks
Doors
Elevators
Feeders
Flooring
Foundry flasks
Frames
Furniture
Interior finish
Kitchen cabinets
Matches
Moulding
Office fixtures
Passenger cars
Patterns
Porch columns
Pumps
Refrigerators
Sash
Ships
Siding
Silos
Store fixtures
Tanks
Threshers
Trunks (boxes)
Tubs
Vehicles
Woodenware

YELLOW POPLAR

Aeroplanes
Automobile bodies
Billiard tables
Boxes
Buggy bodies
Brushes
Cabinets
Cars (finish)
Ceiling
Chairs
Cigar boxes
Drills
Elevators
Excelsior

YELLOW POPLAR — (*Continued*)

Furniture
Instruments, musical
Instruments, professional
Interior finish
Merry-go-rounds (horses)
Packages
Patterns
Plumbers' woodwork
Pool tables
Pumps
Refrigerators
Sash
Ships
Vehicles
Woodenware

SAMPLE TIMBER SALE CONTRACT

AGREEMENT entered into this ..... day of ..... between ..... of ....., county of ....., state of ....., hereinafter called the seller, and ....., of ....., county of ..... state of ....., hereinafter called the purchaser.

WITNESSETH:

ARTICLE 1. The seller agrees to sell to the purchaser, upon the terms and conditions hereinafter stated, all the living timber, marked or designated by the seller, and all the merchantable dead timber, standing or down, estimated to be ..... board feet, more or less, on a certain tract of land, situated on lot number ....., township of ....., county of ....., state of ....., and located on the farm belonging to the seller, and about one mile southeast of his farmhouse.

ARTICLE 2. The purchaser agrees to pay the seller the sum of ..... dollars ($.....) per thousand board feet in accordance with the following schedule of prices:

White oak	$.....	per M. b. ft.
Red oak	$.....	per M. b. ft.
Hard maple	$.....	per M. b. ft.
Hemlock	$.....	per M. b. ft.
White pine	$.....	per M. b. ft.

.....

.....

ARTICLE 3. The purchaser further agrees to cut and remove said timber in strict accordance with the following conditions:

1. Unless extension of time is granted, all said timber shall be cut, paid for and removed on or before .....

2. All timber shall be scaled by the Scribner log rule, and measured at the smaller end, along the average diameter inside of the bark.

3. The maximum scaling length of logs shall be sixteen feet; greater length shall be scaled as two or more logs. Upon all logs an additional length of four inches shall be allowed for trimming. Logs overrunning this allowance shall be scaled not to exceed the next foot in length.

4. No unmarked timber of any kind shall be cut, except (name species).

5. Stumps shall be cut so as to cause the least possible waste; stumps

of trees up to sixteen inches in diameter not higher than twelve inches above the ground and those of trees above this size at a distance above the ground not greater than three-fourths of their diameter.

6. All trees shall be utilized in their tops to the lowest possible diameter for commercially salable material.

7. Young trees shall be protected against unnecessary injury; only dead trees and the less valuable kinds may be used for construction purposes in connection with lumbering operations.

8. Care shall be exercised at all times by the purchaser and his employees against the spread of fire, and the purchaser will be held responsible for fires starting from logging operations.

ARTICLE 4. It is mutually understood and agreed by and between the parties hereto as follows:

1. All timber included in this agreement shall remain the property of the seller until paid for in full.

2. In case of dispute over the terms of this contract, final decision shall rest with a reputable person to be mutually agreed upon by the parties to this contract; and in case of further disagreement, with a board of three persons, one to be selected by each party to this contract and a third to be a State or Government representative.

IN WITNESS WHEREOF the parties hereto have hereunto set their hands and seals this ..... day of ....., 19.....

Witness:

....

....

LIBRARY OF CONGRESS
0 002 818 584 4